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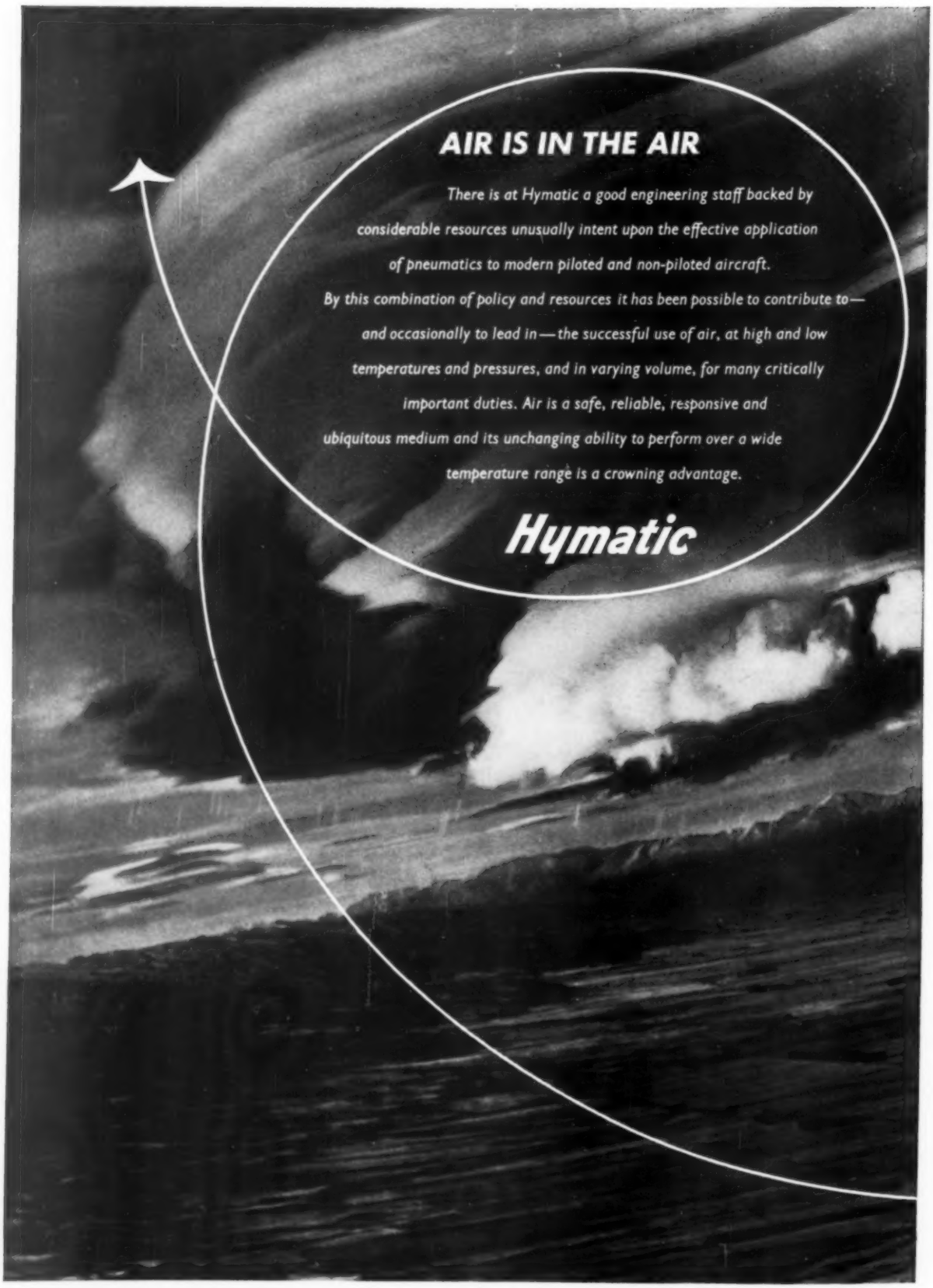
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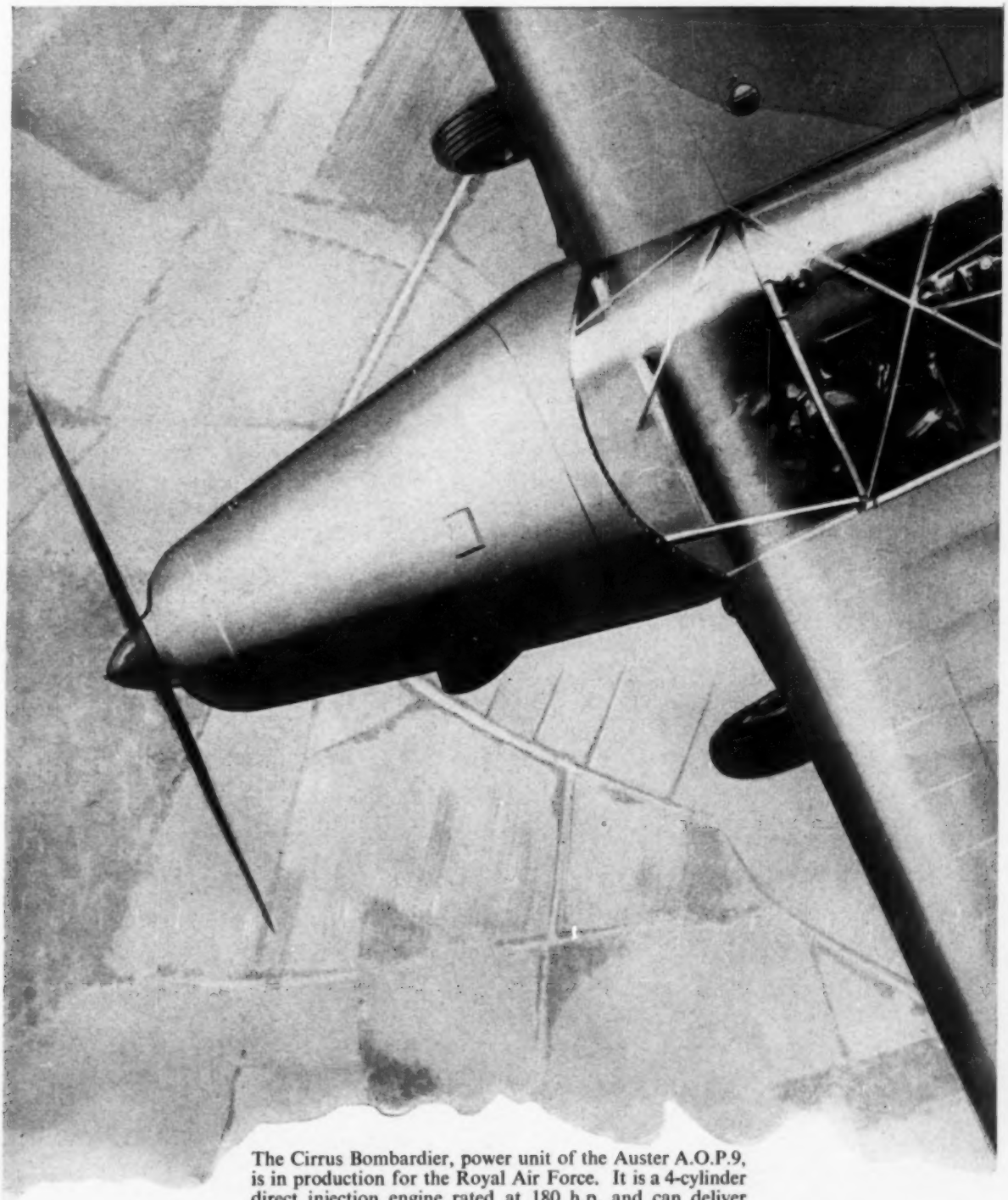

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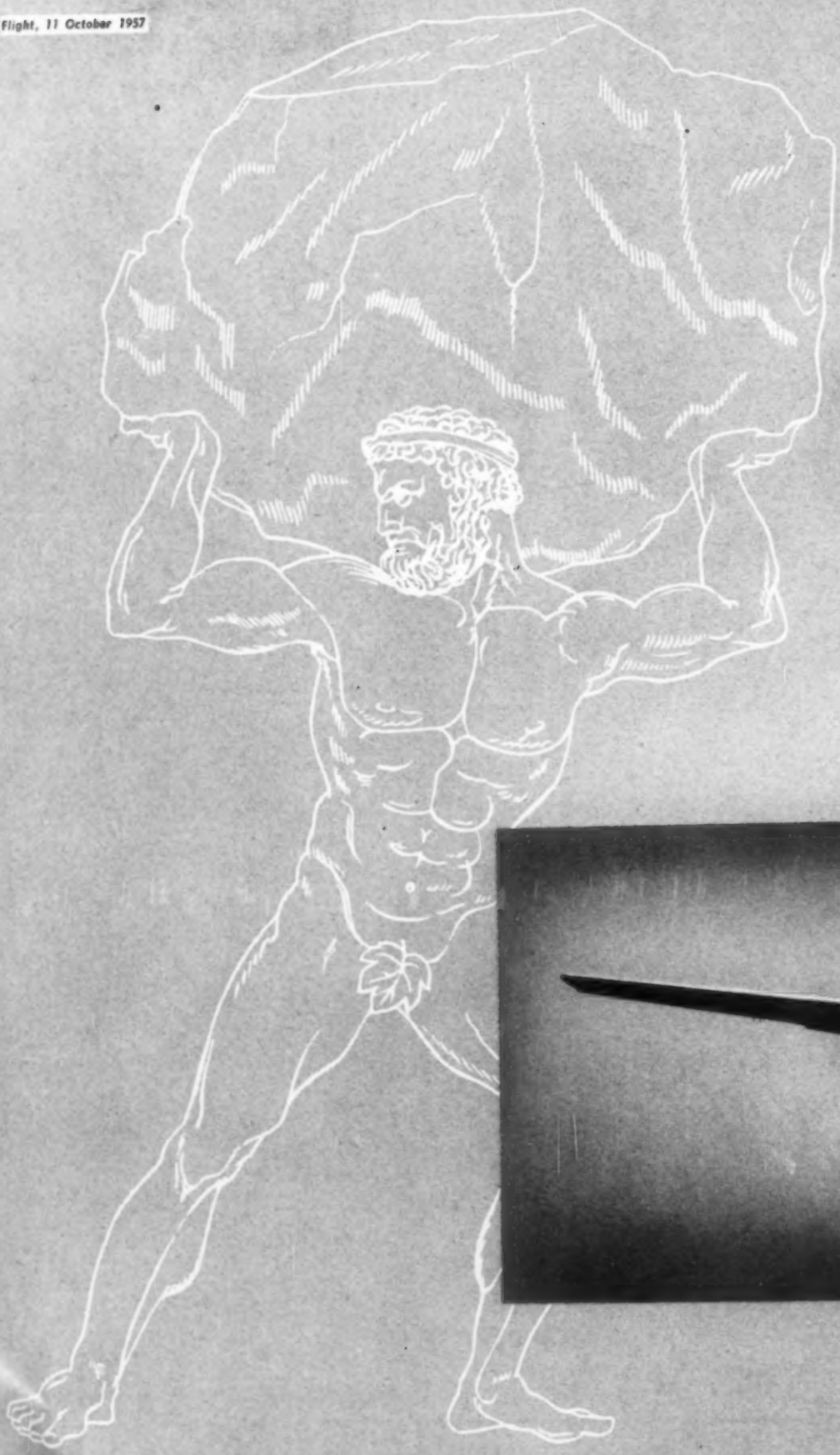

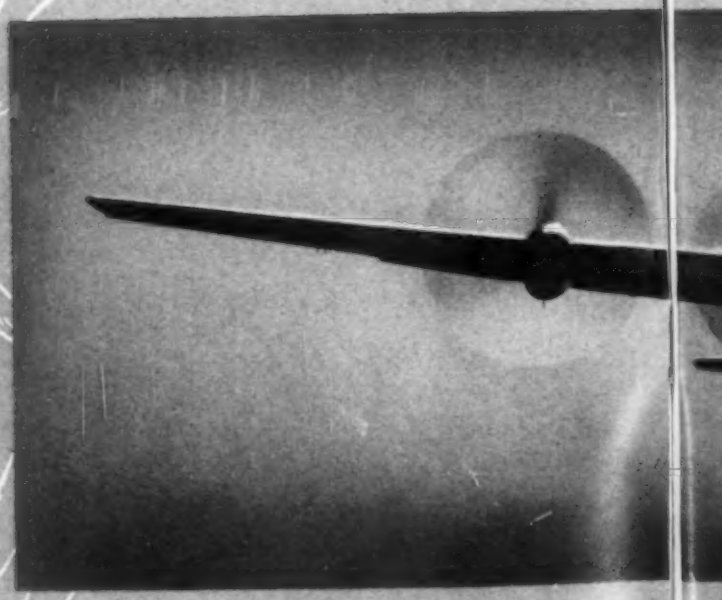

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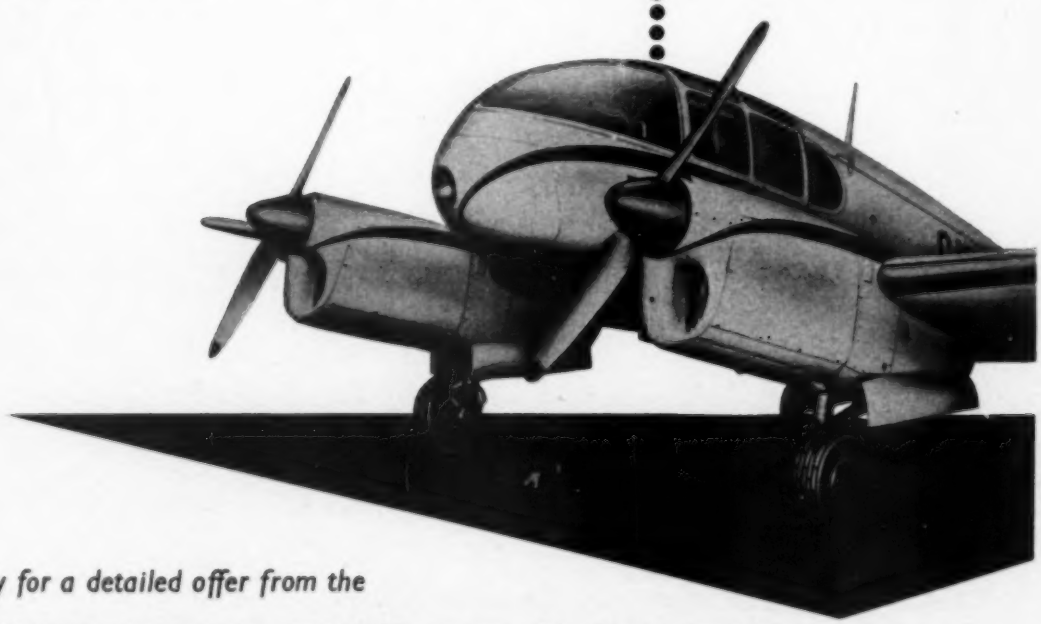

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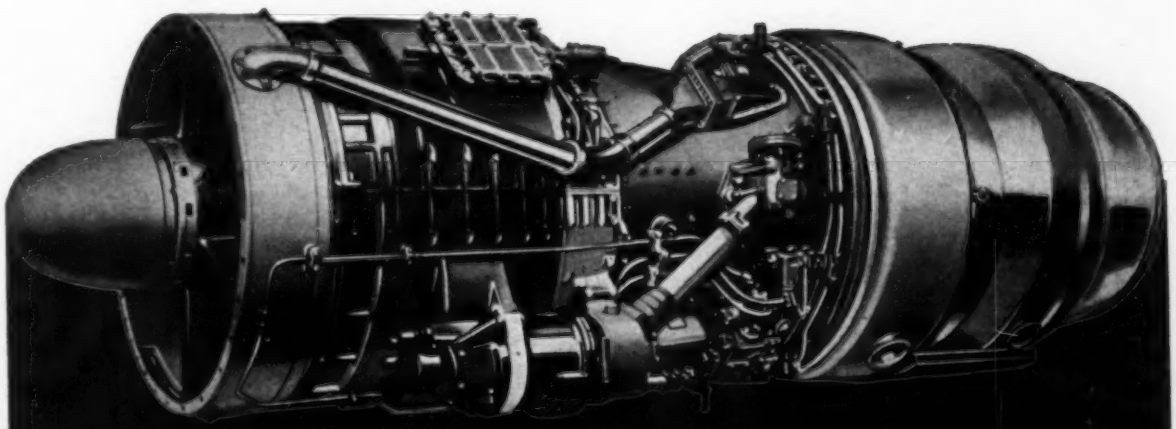

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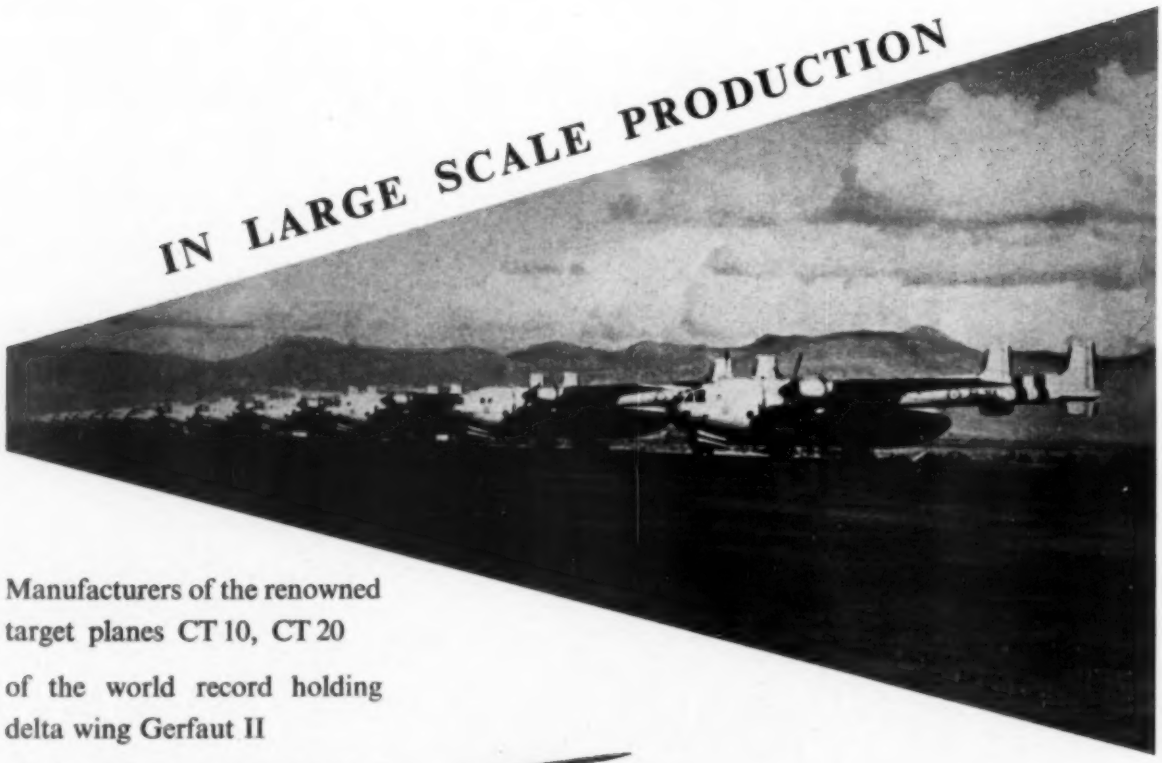

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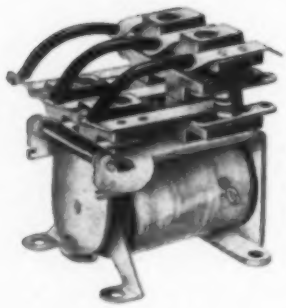

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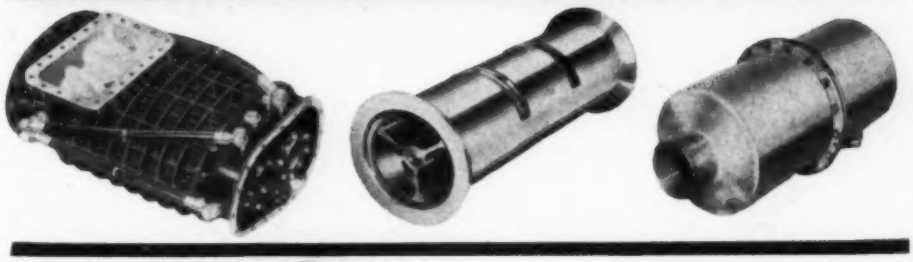

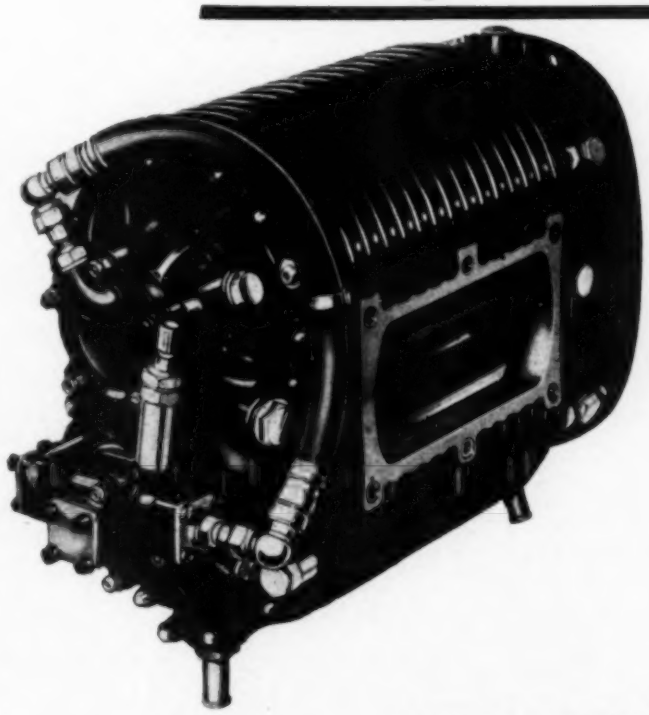

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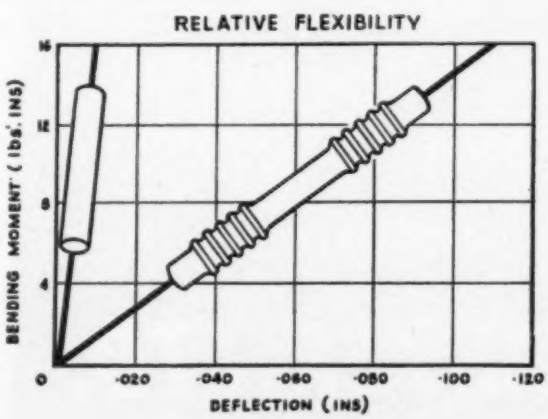

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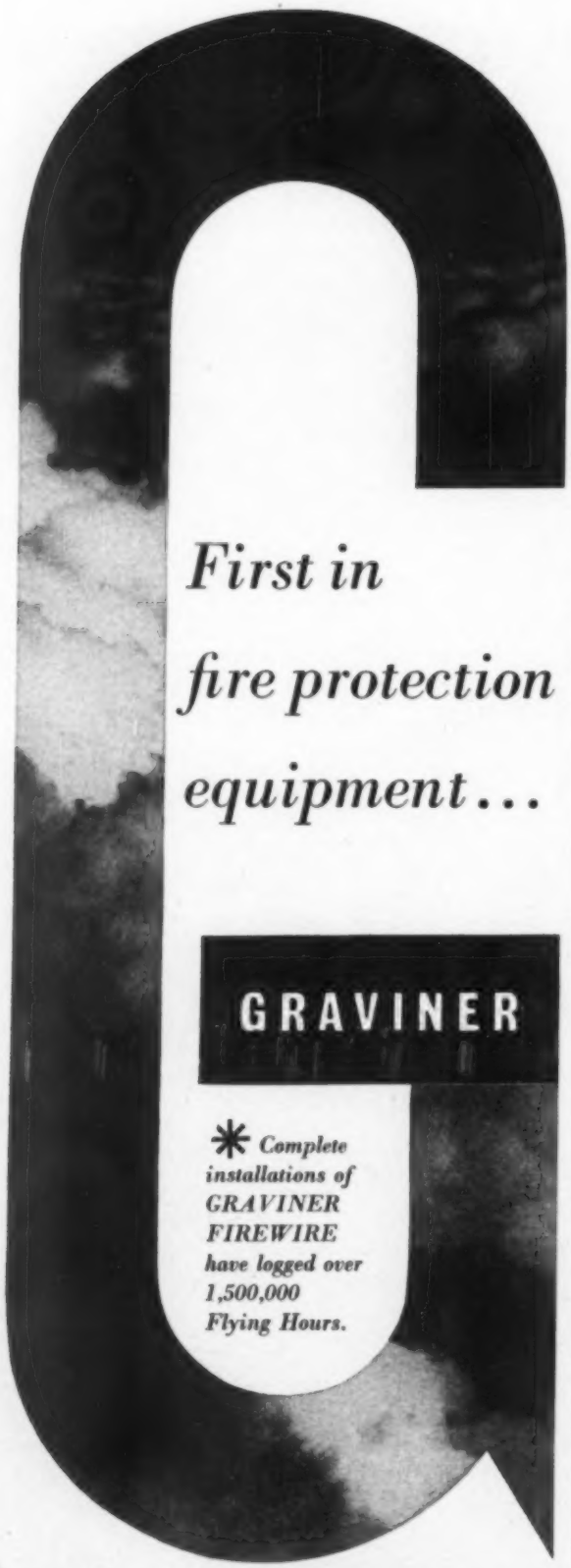

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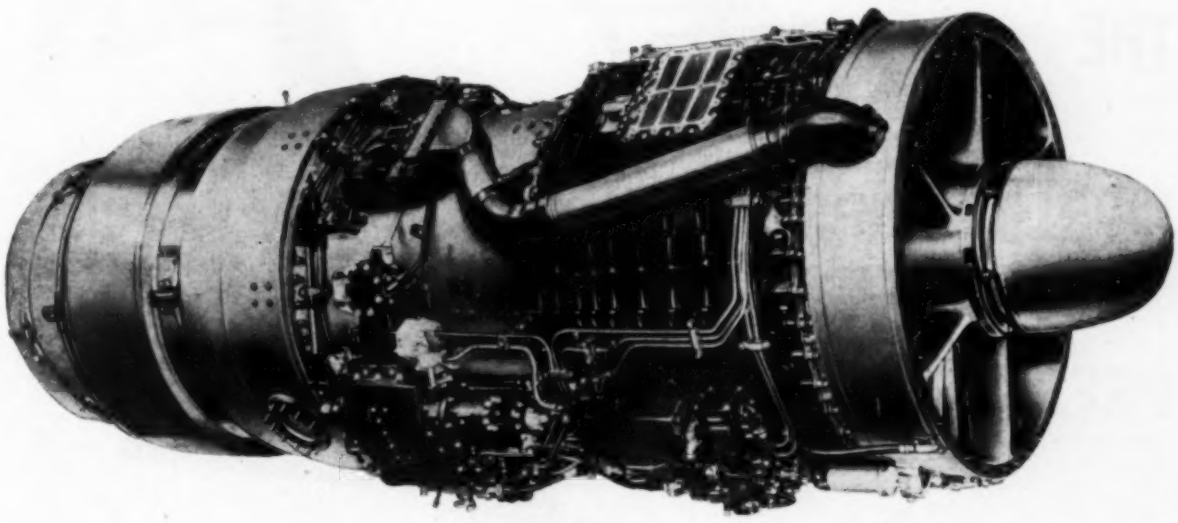

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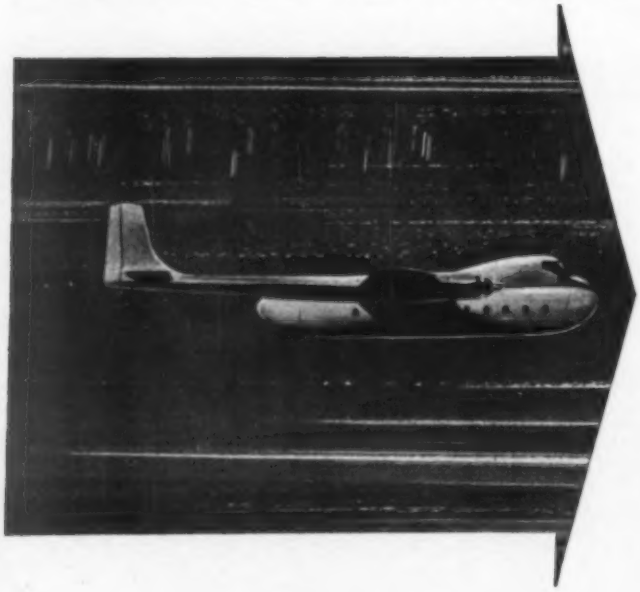

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Associate Editor
H. F. KING M.B.E.

Technical Editor
W. T. GUNSTON

Production Editor
ROY CASEY

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Hitting Below the Radar Belt

THE rapier of olden days must have been a very comforting piece of hardware to have about the person. But many a swordsman finding himself in a really tight corner would doubtless have traded his finest Toledo blade for a foot of lead piping or half a brick wrapped in an old sock. For any weapon can prove a positive embarrassment if circumstances are unpropitious for its use. An air force might have the world's fastest, highest-climbing intercepters, armed with the most diligently target-seeking missiles and backed by the most scrupulously integrated system of ground-to-air defences—and yet find itself impotent in face of a handful of fast bombers attacking "on the deck."

The threat is not, of course, a new one. The relative immunity of the low-level marauder has been exploited in greater or lesser degree ever since the contour-chasing "scout" pilots of 1914-18 discovered how to get the enemy's head down and keep it down. But under present conditions, with supersonic speeds and atomic armament the order of the day, the menace becomes extreme, as the Hunters have given notice at Farnborough for some years past. These, it must be remembered, were flying below the speed of sound; yet the difficulty of hitting them with projectile or missile is precisely the difficulty experienced by our cornered cavalier.

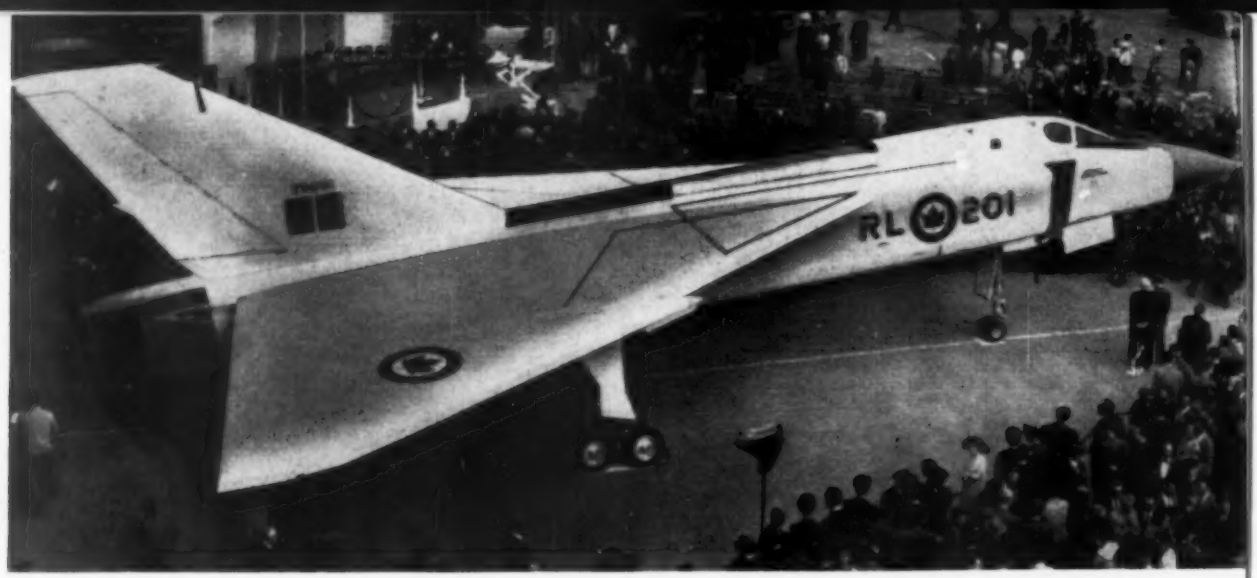
Consider, then, the supersonic strike aircraft feasible today—remembering, too, that the English Electric P.1 has already flown at well over Mach 1 only a few hundred feet above sea level. Combine with such performance the ability to defy radar defences; to navigate automatically, using the latest Doppler aids and an autopilot; and to deliver the nuclear weapon "over the shoulder" and make a quick, safe getaway. Add to these possibilities the confidence of the pilot—feeling like a flitting swift instead of a sitting duck—and the full implications of the threat can be realized.

For work over the longer ranges the pilot, having to conserve his fuel by flying high, could not expect to enjoy immunity throughout his mission. He would be obliged to approach at, perhaps, 50,000ft-60,000ft, and to dive supersonically to a point a few scores of miles short of his target for the run-in. But he would be a happier—if busier—man than if he were cruising continuously at intercepter level, in the full glare of radar coverage and within missile range of ground installations.

An R.A.F. Requirement?

Notwithstanding the categorical assurance of the Minister of Defence that "having regard to the high performance and potentialities of the Vulcan and Victor medium bombers and the likely progress of ballistic rockets and missile defence, the Government have decided not to go on with the development of a supersonic manned bomber . . ." it is worthwhile considering the possible future, in R.A.F. service, of smaller machines capable of high- and low-level bombing. In the first place, it must be supposed that by "supersonic manned bomber" the Minister was alluding to the large "strategic" class of aircraft, and not necessarily the sort that could be considered as a Canberra replacement. This last-named might well be identified with the multi-purpose class of which we have written recently. It might be single-engined, like the Republic Thunderchief (a Mach 2 machine which is pioneering the modern low-level method of attack) or Hawker's P.1121; or it might be a twin, such as the Blackburn NA.39 or North American A3J. It would demand the most advanced structural and aerodynamic techniques, in the development and application of which the Avro Arrow and NA.39, as well as the P.1, will provide invaluable experience; and it will, presumably, require such potent supersonic turbojets as the Orenda Iroquois, de Havilland Gyron or Rolls-Royce R.B.106 (possibly burning the new so-called exotic fuels).

Whatever problems it may pose, the British and Canadian industries between them could, we believe, command sufficient experience and equipment to handle them—a belief which is greatly strengthened, as these words are written, by the first pictures of the Avro Arrow, reproduced on page 562.



WORLD LEADER in its class is the Avro Aircraft Arrow, here unveiled at Malton. (See news item and drawing on this page.)

FROM ALL QUARTERS

First Man-made Satellite

ON October 4 the Soviet Union became the first country to launch a man-made vehicle into an orbit around the earth, and thereby achieved one of the most spectacular scientific advances to date. The following is a slightly abbreviated version of an announcement made in Moscow the following day:—

"As a result of intense, large-scale research conducted by Soviet research institutes and design organizations, the world's first artificial earth satellite has been developed in the Soviet Union. On October 4, 1957, the first satellite was successfully launched in the U.S.S.R. According to preliminary data, the carrier rocket gave the satellite the required orbital speed of some 8,000 m/sec (17,897 m.p.h.). At the present moment the satellite is orbiting the earth along an elliptic trajectory and can be observed in the light of the rising and setting sun through the simplest optical telescopes.

"According to calculations, which are now being verified by visual observation, the satellite will revolve at heights of up to 900 km (559 miles), making one complete revolution in 1 hr 35 min, the angle of its orbit to the equatorial plane being 65 degrees.

"On October 5 the satellite will pass twice over the Moscow area, at 0146 and at 0642 hr Moscow time. Reports on the subsequent movement of the satellite will be broadcast regularly by Soviet radio stations. The satellite is in the form of a sphere with a diameter of 58 cm (22.835in), and weighs 83.6 kg (184.3 lb). It carries two radio transmitters emitting signals at 20.005 and 40.002 Mc/s (some 15 and 7.5 m wavelength). The transmitters are powerful enough to ensure good reception by many amateur radio operators. The signals are sent in the form of telegraph messages lasting some 0.3 sec with intervals of the same duration; the signal on one frequency being sent during the pause in the transmission on the other.

"Since the density of the rarefied upper layers of the atmosphere is not known for certain, no data are at present available for determining with precision the duration of the satellite's existence and the place where it will enter the dense layers of the atmosphere. It has been calculated that because of its tremendous speed, the satellite will burn up on reaching the dense layers of the atmosphere at the height of several score of kilometres.

"The possibility of cosmic flight with the help of rockets was first scientifically substantiated in Russia, as early as the end of the 19th century, in the words of the outstanding Russian scientist Konstantin Tsiolkovsky. The successful launching of the first man-made satellite makes a tremendous contribution to the treasure house of world science and culture. . . . The Soviet Union proposes to send up several more satellites during the IGY. These will be bigger and heavier and will help to carry out an extensive programme of scientific research."

Since the first communique was broadcast, Moscow radio commented further in frequent announcements. Thus, at 1215 G.M.T. on October 5, Moscow reported:—

"At 1204 Moscow time the satellite's position was in the area of the city of Johannesburg. Since the moment of its passage over the Moscow area at 0146 on October 5, it has circled the earth about 6½ times. The period of its orbit round the world, according to precise assessment, lasts 96.2 min. The radio transmitters are working uninterruptedly. . . . The appearance of the satellite is expected today in the areas of the following cities (Moscow time): Detroit, 1630; Washington, 1631; Magadan, 1752; Calcutta, 1916; Ulan Bator, 1923; Karachi, 2054; Alma Ata, 2058; Baghdad, 2232. On October 6: Yakutsk, 0025; Prague, 0149; Riga, 0151; Moscow, 0152; Oslo, 0327; Rangoon, 0528; Bandoeng, 0535; Leningrad, 0649; Moscow, 0650; Bombay, 0703; Damascus, 0834; Manchester, 1005; Paris, 1006; Rome, 1009.

On October 5 the B.B.C. Monitoring station at Caversham, Berks, reported the following observations on the 20 Mc/s signal: *First transit:* 0002 G.M.T., weak signal; 0005, increasing; 0015, variable; 0023, strong and clear; 0025, weakening; 0026, out. *Second transit:* 0140, very weak; 0145, increasing; 0200, strong; 0205, weakening; 0206, out. *Third transit:* 0325, very weak; 0339, increasing; 0340, peak reception; 0350, out. *Fourth transit:* 0510, very weak; 0517, increasing; 0522, peak reception; 0530, out. Signals were clearly audible in the 20 Mc/s band, but very poorly received in the 40 Mc/s band, where the signal, though audible, hardly rose above the amplification noise level.

It appears unlikely that the Russian satellite is carrying any instrumentation; but such equipment is certain to be carried by its successors and also by the smaller American satellites which are scheduled to be launched early next year. It is not yet known whether this successful satellite firing was preceded by failures. Nor is there information about the launching vehicle, apart from Soviet statements that it comprised three stages, the first powered by a 264,000-lb motor burning out at about 4,500 m.p.h., the second with a 79,000-lb motor burning out at something over 12,000 m.p.h. and a third with a small motor designed to give a tangential push and establish the satellite in its orbit.

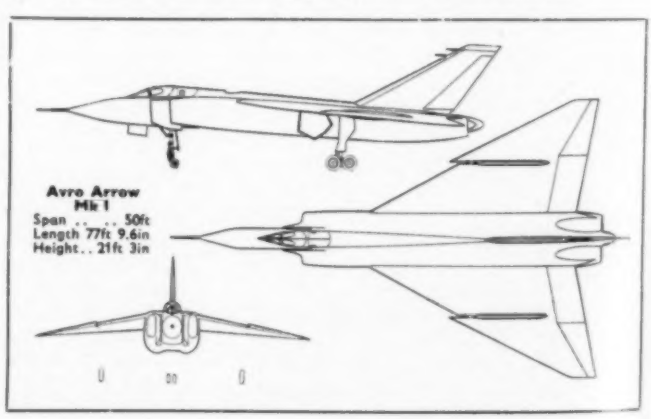
The Arrow Unveiled

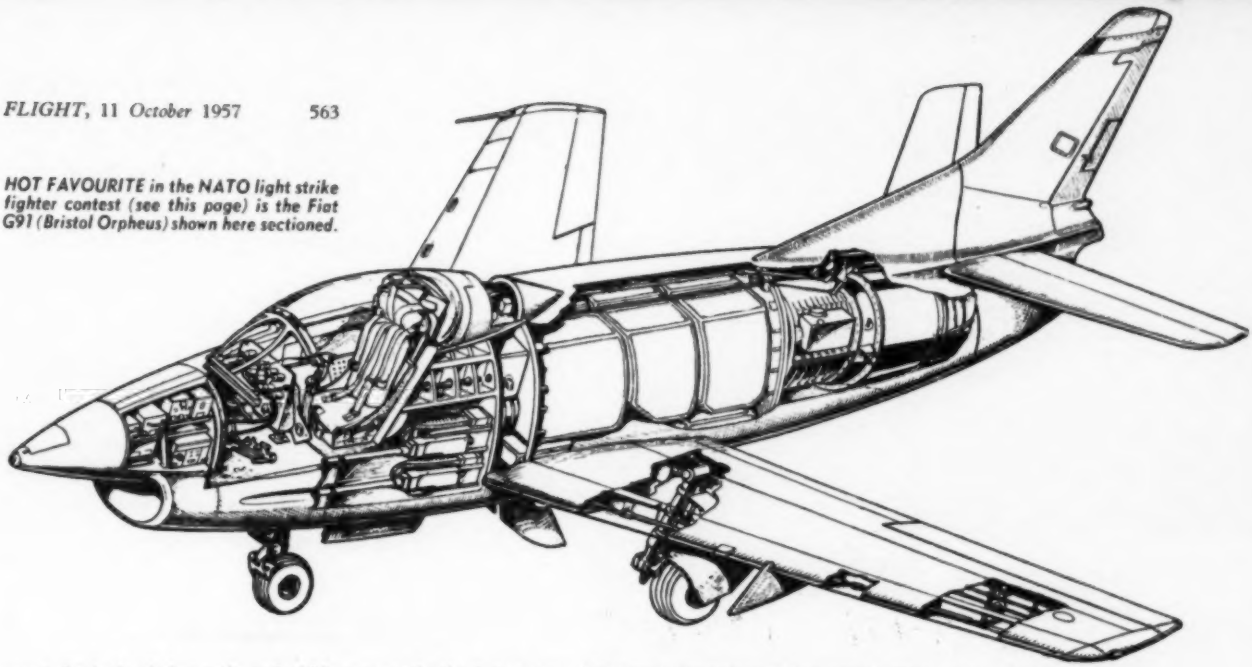
A WEEK ago—on Friday, October 4—the first Avro CF-105 Arrow Mk 1 was "rolled out" from the company's plant at Malton, Ontario. The following are extracts from an announcement issued at the time:—

"Canada's first supersonic aircraft, was unveiled today (Friday) at Avro Aircraft, Ltd., Malton, Ontario. On a signal from Mr. George R. Pearkes, V.C., Canadian Defence Minister, the huge white delta-winged fighter emerged from the production bay before a massed gathering of government, military, civic and industrial leaders while CF-100s, flown by Avro test pilots, swooped low in salute. Representing the Hawker Siddeley Group's parent body in the U.K. was Sir Roy Dobson, Group director and chairman of A. V. Roe Canada, Ltd.

"This was the first public viewing of the supersonic successor to the CF-100. Initial flight testing of the Arrow—formerly known as the CF-105—will be carried out from Malton.

"Roll-out of the first Arrow, in a record four years from the time Avro was given the 'go-ahead,' climaxes a mass of engineering research and manufacturing techniques in fields completely unknown when the project was undertaken. It was in July 1953 that the Canadian govern-





***HOT FAVOURITE** in the NATO light strike fighter contest (see this page) is the Fiat G91 (Bristol Orpheus) shown here sectioned.*

ment authorized a design study, and within two months the first wind-tunnel tests were being run. . . .

"Wind-tunnel limitations caused Avro engineers to explore further techniques for obtaining important aerodynamic data. Eleven large-scale free-flight models with rocket-propelled boosters were fired at ranges in Canada and the United States between 1954 and January of this year. . . .

"During 1954, when preliminary design was completed, the Royal Canadian Air Force adopted the CF-105 designation for the aircraft. Later in 1954, powerplant problems arose which required major changes in the proposed programme. The Rolls-Royce R.B. 106 engines [not previously publicly mentioned—Ed.] would not be available in time for the CF-105, and were replaced by two Curtiss-Wright J67 engines [developed from the Olympus—Ed.]. Then, in early 1955, the U.S.A.F. disclosed that the J67 would also not meet the Avro schedule. At this point the programme now in effect was established—the installation of Pratt and Whitney J75s, as an interim measure, and Orenda PS.13s (Iroquois) when they become available.

"From the time the basic configuration was established to the end of 1956, up to 460 engineers, technicians and draughtsmen worked on the design and development of the Arrow and its systems. Aerodynamically the Arrow was entering a new realm of science. Performance, stability and control problems were difficult to evaluate, and data had to be obtained to establish air loads on the wing, fin, canopy and control surfaces . . .

"The procurement department began negotiations which resulted in over 650 suppliers being established, and, as the programme progressed, more than 5,000 people were found to be employed outside Avro in the manufacture of Arrow parts and tools. . . . The first Arrow was completed in under 30 months from the first design-release. In addition, the man-hours-per-pound expended on the first machine were approximately 80 per cent of that of projects of similar size and complexity throughout the aviation industry in North America.

"It is now four years since the design started. This is considered better than average for the time required to design and build present-day high-performance aircraft. The present Arrow is on the threshold of the heat barrier, and studies are now under way to adapt the aircraft for even higher speeds to pierce this barrier."

The NATO Contest

THE NATO Contest handling trials of the five NATO strike fighters were completed last Saturday at Brétigny, near Paris; and the committee headed by Dr. von Kárman, President of A.G.A.R.D., is now deliberating on the pilots' reports. The tests covered the normal flight conditions generally investigated during the fairly early test-flying period, though handling during taxying on and flying from rough ground was included. Full-load take-offs and landings with the required armament loads were also made. In cases where intimate acquaintance with the aircraft was required to obtain optimum performance, company pilots were substituted for the NATO team. A German test pilot flew the five aircraft in a separate evaluation for the German Government, which has shown great interest in the types.

A full description of the French aircraft concerned appeared in *Flight* for June 7; and the difficulty of installing the larger Orpheus 12 engine was then noted. This engine is slightly larger than present BOr.3 and requires greater air-intake capacity and more fuel. It is a moot point, therefore, whether the present airframes can be said to represent the final production models since these will now have to be fairly extensively reworked. Nevertheless, the deliberations continue and, after tactical trials, a decision on production is hoped for during the next few months. The 27 Fiat G91 already ordered will be used in an experimental squadron investigating tactical applications for light strike fighters in general. The Fiat G91, incidentally, is reported to have performed remarkably well at Brétigny.

Antarctic Rescue

TWO members of the British Transantarctic Expedition, F/L. G. Haslop and Dr. A. Rogers, were rescued last week after having spent 11 days on the ice following a forced landing in their Auster owing to bad weather.

In a dispatch from Shackleton base the leader of the expedition, Dr. V. E. Fuchs, described how the rescue was accomplished by the use of the "Sarah" air-sea rescue system. S/L. J. Lewis, with Mr. D. Stratton as his navigator, took off from Shackleton in an Otter to try to locate the Auster. They set course for Halley Bay and then flew 40 miles beyond it, but finding nothing returned to Halley to refuel. Before taking off again they set up a Sarah beacon there, and meanwhile Shackleton had told Haslop to switch on the Auster's Sarah. The Otter picked up its signal only 20 minutes after being airborne, and shortly afterwards landed beside the Auster, which was subsequently refuelled.

Both aircraft then flew together back to Halley Bay. Dr. Fuchs reports that the stranded men—"both well, although somewhat thinner"—had been living in a hole in the snow, protected by the Auster's engine cover.

***PRESENTED** by Cellon, Ltd., with Roy Nockolds' oil painting of the formation aerobatic Hunters (which wear the company's epoxy finishes) at the Farnborough display: No. 111 Sqn., whose C.O., S/L. R. Topp, is seen after receiving it with Mr. Aubrey Barr (left) director; Mr. Nockolds; and W/C. J. C. Cantrill, manager, aircraft finishes dept. The aircraft are finished in the Cellon "CC" scheme in black (which shows them up well) and it is said to have been "eminently satisfactory."*

"Flight" photograph

FROM ALL QUARTERS . . .

London Sky-writing

TWO Harvards ejecting white smoke from their exhaust manifolds drew a face and then wrote the name "Lexington" and the telephone number Welbeck 1131 in the sky over London on October 2. Conditions were ideal for such an exercise, calm and with scarcely any cloud; and the writing attracted a great deal of attention as it was done between 1 p.m. and 2. It also aroused much curiosity, and not only Welbeck 1131 was telephoned. U.S. Navy headquarters was asked if the name referred to the U.S. aircraft carrier; a firm called Lexington Products modestly admitted that it was only coincidence that they had received such publicity; Air Ministry disclaimed any responsibility (as did the U.S.A.F.); and spectators with experience of Continental brands affirmed that Lexington was a Dutch make of cigarette.

The face in the sky.

These pundits were right; but the writing in the sky was not carried out on the instructions of the Dutch company. It was done by Mr. W. J. Thompson and Capt. H. Creed of Overseas Aviation as a means of advertising that company's skill in the art, which they display regularly. Mr. Thompson and Capt. Creed had come to England to write 21st birthday greetings over Pinewood Studios for the J. Arthur Rank organization on September 30. They were unable to do so because of unfavourable conditions; and on October 2 they had actually started off from Croydon for Holland when they found conditions over London too good to miss for doing a little self-advertising.

They operated at between 13,000 and 14,000ft, reducing speed to about 110 m.p.h. for their writing, which is done with the help of a special chemical mixture in the oil used to produce white smoke. "Lexington" is a word they are accustomed to writing over Holland, and the telephone number is that of the London office of Overseas Aviation, which has its headquarters at Overseas Motor Sales Luftfahrt Abteilung, Frankfurt, and another office at 26 Hill Street, St. Helier, C.I.

IN BRIEF

Mr. G. E. Beharrell has been elected chairman of the Dunlop Rubber Co., Ltd., in succession to Lord Baillieu.

* * *

Some 250 delegates from all over the country were attending the Conference for Modern Technological Education for Industry, held at Cheltenham on Wednesday and Thursday of this week.

* * *

An order for plastic drop tanks for Indian Air Force Hawker Hunters is the largest export order given to Bristol Aircraft for these components. It brings the value of their drop-tank exports to over £250,000.

* * *

The next Lighter-than-Air Reunion—for ex-airship crews and technicians—is to be held at Simpson's-in-the-Strand, London, on Friday, November 22. Details from the hon. secretary, Mr. J. Fairley, 7 Coopers Close, Kimpton, Herts.

* * *

Expansion of the electronics division of F. G. Miles, Ltd., has led to the formation—in association with Lombard Development Corporation, Ltd.—of a new company, Miles Electronics, Ltd. Further details will be given in our pages next week.

* * *

The 1957 joint meeting of the Canadian Aeronautical Institute and the Institute of the Aeronautical Sciences is being held on October 21-22. Principal speaker will be Mr. Gordon R. McGregor, president of Trans-Canada Air Lines, who will discuss *The Economics of Civil Turbine Operations.*

AIRCRAFT OF 1914-18: J. M. BRUCE'S INCOMPARABLE BOOK

FIVE years ago (writes the Associate Editor) I was piously contemplating the writing of a standard work on British military aircraft. The first volumes (for the labour was to be exhaustingly exhaustive) were to be consecrated to the heroic aeroplanes of 1914-18.

It so happened that the tide of my enthusiasm for this marvellous project was running especially high (probably because some thrilling new variation of the Scarff gun-ring had come to light), when there arrived at *Flight* a letter of singular neatness and modesty, submitting for editorial consideration a substantial typescript detailing the history of the D.H.4. The signature—"J. M. Bruce"—might well have been appended to the death warrant of my own project for posterity, for the accompanying article was of such scope and profundity that any hope of rivalry was shrivelled on the spot.

Thenceforth the story was one splendid progression of "Bruces" (as we soon came to know them on *Flight*), each a model of research, authority and authorship. The D.H.4 history appeared in our issue of October 17, 1952. In turn came the Bristol Fighter, F.E.2 Series, Handley Page 0/100 and 0/400, S.E.5, Sopwith Pup, B.E.2 Series, Avro 504, R.E.8, Sopwith Camel, Felixstowe Flying-Boats, D.H.9, D.H.9A, Sopwith 1½-Strutter, Short Seaplanes; and the most recent was the Sopwith Triplane (April 19 and 26, 1957). Each evoked new expressions of amazement and acclaim from *Flight* readers, and before long it was hardly worth while to ask our Publishing Department if an issue containing a Bruce remained in stock.

There was nothing dusty or musty about these stories. Old myths were successively demolished; new facts by the hundred were placed on public record after 35 or 40 years.

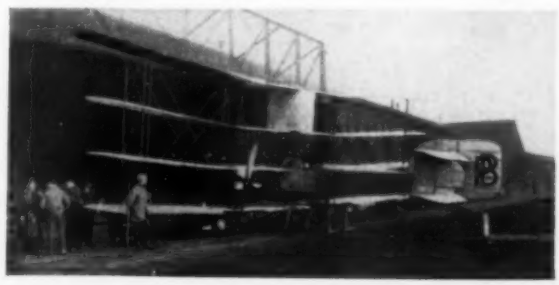
And so this truly historic series will, we hope, continue.

These prodigious efforts, it might be supposed, would have commanded every leisure moment even of J. M. Bruce; but, in fact, they represent only a portion of his output in recent years. His residual energy has gone to the making of a book*—a weighty, wondrous 12-guineas-worth of book, quite unapproached, in its uncompromising standards of excellence, by any other in the literature of military aircraft. The authors' own description of it is characteristic: "This book attempts to record the British aeroplanes which flew or were designed during the war years. It therefore includes notes on several types which were designed before the war and others which did not fly until after the Armistice. It would be rash to assert that every British aeroplane of the period is included. All that can be said is that this history contains references to all types and variants known to the author."

In 740 glossy pages, measuring 8½ × 11in, some 250 aircraft types and hundreds of variants are depicted in 657 photographs, and described in 400,000 words. Among them are machines which few enthusiasts can ever have heard named, far less have seen illustrated. The monstrous A.D.1000 twin-hull seaplane, for instance; the freakish Armstrong Whitworth F.K.12, in its two forms; the Avro 510, 519 and 512; the Dyott Bomber; Grahame-White experimental two-seater; Holle Varioplane; Mann, Egerton H.1 and H.2 ship-borne fighters; Nestler Scout; British Nieuport B.N.1; Parnall Scout; an F.E.2a with a braking parachute (!); Saunders T.1; Siddeley R.T.1; Pemberton-Billing P.B.29; White and Thompson "Bognor Bloater"; Vickers F.B.16, with Hart radial engine; Wells Reo; Whitehead Scout; and a regular phantasmagoria of Wights.

This splendid book will assuredly win the acclaim of true *amateurs* of 1914-18 aircraft the world over; and equally it deserves the gratitude of the entire British aircraft industry.

*"*British Aeroplanes 1914-18*," by J. M. Bruce. Putnam and Co., Ltd., 42 Great Russell Street, London, W.C.1. Price 12 guineas.



RARE BIRDS, saved from historical extinction by J. M. Bruce and included in his book, reviewed above, include these three—right, Pemberton-Billing P.B.29 night-patrol aircraft; below, an Admiralty-owned Avro 519; lower right, British Nieuport B.N.1 fighter.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

This fine study of No. 94 Squadron's aerobatic team—led by the C.O., S/L. D. G. L. Heywood, with F/O. Stock as No. 2, F/L. D. C. Evans (No. 3) and F/O. J. G. F. Smillie (box) — was taken by the squadron adjutant, F/L. J. N. Dymond, from a Vampire T.11 flown by F/O. P. G. Wildgust. No. 94 Sqn. is one of the units now being disbanded in 2nd T.A.F.

Mosquitoes Still Attacking

OPERATING from Schleswigland, near Hamburg, R.A.F. Mosquitoes are daily being heavily engaged by German A.A. defences—though by contrast with similar wartime activities these have the full approval of both sides. The aircraft—TT. 35s—belong to the R.A.F.'s sole remaining Mosquito unit, which is commanded by F/L. K. M. Cotter and forms part of the armament practice camp at Schleswigland. The A.A. gunners operate on the NATO ranges at Todenhorf, near Kiel, and the C.O. of one German unit there claims to have had F/L. Cotter in his sights during the Anzio landings when he was flying Mosquitoes with No. 23 Sqn.

Eight T.T. 35s are kept serviceable at R.A.F. Schleswigland, which holds all its own spares. There is also a Mk 6 which, with guns removed, is used for dual flying training. Engines are in good supply, but airframe and equipment details often have to be made on the spot.

Eight TT. 35s are kept serviceable at undertaken, and the pilots report that the best light ack-ack marksmen are those of the R.A.F. Regiment—who easily hold their own with NATO units of the British Army and other nationalities.

Senior Medical Appointment

HAVING served in Aden since 1956 as Senior Medical Officer, Arabian Peninsula, and Officer Commanding the R.A.F. Hospital, A. Cdre. S. R. C. Nelson has now been appointed Principal Medical Officer at H.Q. Technical Training Command.

A Canadian, A. Cdre. Nelson joined the R.A.F. Medical Branch in 1935. Early in the war he served with No. 45 Sqn. and at H.Q. Middle East, then after being at H.Q. No. 10 Group he went to Canada with the U.K. Air Liaison Mission from 1943 to 1945, when he joined the R.A.F. Delegation in Washington for a three-year tour. Before going to Aden, he returned to the Middle East as No. 205 Group S.M.O.

Scottish Benevolent Fund

IN Edinburgh recently it was stated that the Scottish branch of the R.A.F. Benevolent Fund had spent £210,230—from its foundation in November, 1947, to July 31 this year—on 15,649 awards for the relief of distress among serving and ex-service members of the R.A.F. and W.R.A.F. and their families and dependants. For the twelve months ending July 31, some £16,769 was disbursed in 1,137 awards.

No. 38 Group Memorial Gift

GIVEN "in memory of our fallen comrades in the last war," a silver chalice and paten are to be presented to the R.A.F. Church, St. Clement Danes, by No. 38 Group Old Comrades Association. The total cost will be approximately £75, and the Association asks that any ex-members of No. 38 Group who wish to be associated with it should send their contributions to the hon. assistant secretary, Mrs. L. C. Rendall, Hotel Metropole, Brighton, Sussex.

R.A.F. Appointments

BELOW is continued a list of R.A.F. appointments recently announced by Air Ministry:—

W/C. A. P. Crowley to H.Q., No. 11 Group, for technical staff duties; W/C. R. C. Fordham to R.A.F. Cottesmore, for technical duties; W/C. R. N. Harris to Air Ministry, for duty in the Department of the Air Member for Supply and Organization; W/C. H. M. C. Harwood to H.Q., No. 90 Group, for administrative staff duties; W/C. T. G. E. Price to H.Q., Technical Training Command, for technical staff duties; W/C. A. M. R. Ramsden to SHAPE, for staff duties; W/C. H. Tebboth to No. 7 Maintenance Unit, for administrative duties; W/C. O. R. Toyne to No. 3 Movements Unit, to command.

S/L. P. S. Gage to Ministry of Supply (with acting rank of wing commander); S/L. G. N. Rushen to H.Q., Fighter Command, for technical staff duties (with the acting rank of wing commander).

IN BRIEF

During the recent NATO exercises the aircraft carriers *Ark Royal* and *Bulwark* used their new flight-deck magnetic broadcast systems operationally for the first time.

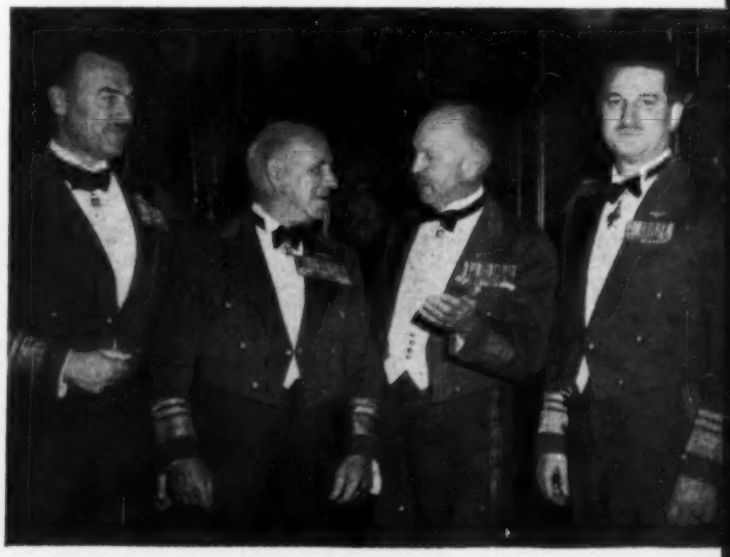
* * * * *

A memorial to the French airmen killed or missing on wartime bomber operations from R.A.F. Elvington, near York, was unveiled at the airfield (now used by the U.S.A.F.) by the French Ambassador, M. André Chauvel, on September 28.

* * * * *

The two R.A.F. Hunter aerobatic teams which have performed at the major European air displays during 1957—from No. 111 Sqn., representing Fighter Command, and from No. 93 Sqn., representing 2nd T.A.F.—have been seen by more than two million spectators in eight countries.

R.C.A.F. Chiefs of Staff—three past and one present—at a dinner given in Ottawa recently for Air Marshal C. R. Slemon (on left of group), formerly C.A.S. and now Deputy Commander, North American Air Defence Command. His successor, Air Marshal H. L. Campbell, is on the right; in the centre are Air Marshal R. Leckie (1944-47), with Air Marshal W. A. Curtis (1947-53) on his left. Pictured below at the presentation of standards to Nos. 3 and 77 R.A.A.F. Sqns. are Air Marshal Sir R. Williams (right), first C.A.S. of the R.A.A.F., with the Minister for Air (Mr. F. M. Osborne) and A. Cdre. C. W. Pearce.



CIVIL AVIATION

THE BRITANNIA'S TROUBLES

"THINGS have got so out of perspective it just isn't funny any more. All aircraft have teething troubles." This was how Mr. Donald Stewart, Bristol's manager of Britannia production, was quoted last week. It seems that the Britannia is so newsworthy that it can nowadays scarcely suffer a delay from bad weather without adverse publicity.

This is not to underrate the Britannia 102's technical troubles, which have caused and continue to cause serious delays to B.O.A.C.'s services. But things *have* got a little out of perspective. If, for example, revenue hours flown per day are acceptable as a fair measure of a transport's progress, then the Britannia 102 has little to be ashamed of. The revenue utilization is at present 6½ hr per day per aircraft, a figure which after seven months of service is higher than has been attained by any other basically new type in a comparable period.

Of course it does not help the Britannia, the passengers who fly in the aircraft, or air transport in general to suggest that all is going well. Nor does it help B.O.A.C. to compare the Britannia's serviceability record with the early days of the Constellation, DC-6 or Stratocruiser. If such a comparison were made by someone with the time to spare it would no doubt be found that the Britannia's teeth-cutting troubles are about average; but it seems that the Bristol product differs from the American aeroplanes—which were rarely news—in the degree of publicity accorded to it.

A disappointing Proteus 755 incident last week was the double-feathering suffered (in the maximum limelight) by B.O.A.C.'s first 312, G-AOVB, during an ice-hunting sortie on September 30 based on New York. Capt. Donald Anderson of B.O.A.C. was in command and Bristol's chief test pilot, Walter Gibb, was on board. The aircraft was apparently cruising at 22,000ft when—it is thought—the shock-chill effect of penetrating a cu-nim caused contraction of the compressor casings of Nos. 2 and 4 engines, with resultant damage from compressor blade-rub. The aircraft landed at Miami, the nearest convenient airport. A similar incident (to G-AOVA) occurred in August near Entebbe, and though production modifications (involving blade-cropping) were put in hand, they had not been made to existing engines, such as those installed in G-AOVB. The position now is that all existing, as well as production-line, Proteus 755 engines are to be retrospectively modified.

G-AOVB's two damaged engines were flown back to Filton for examination last week, and replacements were flown to Miami (one was already available in New York). In the meantime, the A.R.B. have put a precautionary limit on Proteus 755 and 705 compressor r.p.m. of 11,350—in effect a waiver of the recent permit to increase r.p.m. from this figure to 11,500.

SWEDISH DECCA

ON Wednesday of last week, October 2, H.R.H. Prince Bertil of Sweden officially inaugurated the Swedish chain of Decca Navigator stations. Established at the request of the Royal Swedish Navy for their own special purposes, it will also be available for general sea and air navigation.

The ceremony was performed by Prince Bertil on board the cruiser *Tre Kronor*, *en route* from a naval base near Stockholm, to Saltsjöbaden. Two destroyers escorted the cruiser, carrying parties of guests who heard inaugural speeches over the R/T. Each ship was equipped with a Decca receiver and a Track Plotter, the marine counterpart of a Flight Log.

Subsequently an official dinner was held—in the Town Hall at Stockholm—during which Hovauditor Sune Wetter proposed the toast of the guests and also thanked the Decca company and Viceamiral Stig H:son-Ericson for their help in connection with the opening of the chain.

An operating metal mock-up of the Douglas DC-8's clamshell thrust-reverser for the J57. It is being demonstrated by Mr. E. F. Burton, chief engineer of Douglas' Santa Monica division. The doors are retracted hydraulically and lie flush with the engine pod.

Dir. Olle Wageus, managing director of Decca in Sweden, proposing the toast of the Royal Swedish Navy and Swedish shipping, traced the history of the Decca company and Navigator and mentioned that it was five years to the day since the Swedish company was formed.

Mr. E. R. Lewis, chairman, Decca Navigator Co., Ltd., recalled that it was ten years since Decca's first contact with Sweden, and paid tribute to the teamwork of Messrs. W. J. O'Brien and Harvey Schwarz. Viceamiral Stig H:son-Ericson proposed the toast of the hosts.

After the official ceremonies, demonstration flights in a Viscount 701 equipped with Mk VII Decca and piloted by Capt. Ben Wright were given to representatives of the Navy, Air Force, S.A.S., government departments and others interested. The Mk VII receiver, which is the present standard Decca receiver on aircraft of the Viscount type, will soon be superseded by the Mk X.

Two days later, on Friday, another Decca enterprise was taken a step further when the Dectra-equipped M.o.S. Valiant flew from Boscombe Down direct to Montreal to make the first air trial of the ranging pattern. The aircraft changed over from European Decca to Dectra at 10 deg W, and beyond Newfoundland it checked on Dectra back-cover and on the Canadian Decca chain. It is stated that the test was completely successful, with no breaks at the transition points.

PROTEUS IN PERSPECTIVE: A POSTSCRIPT

THE following letter has been addressed to the Editor by Mr. C. B. Bailey-Watson, public relations manager of the Bristol Aeroplane Company:—

"I should like to express our great appreciation of the notes you published on the Bristol Proteus in your issue of September 27. The record of serviceability and reliability of this engine in B.O.A.C. service is, however, even better than you have given your readers to believe.

"Referring to unscheduled removals, 49 in 59,477 engine hours represents a rate of 0.824 per 1,000 hr which is significantly better than the rate of 1.2 which you quoted and does, indeed, compare almost directly with the record you give for the piston engines in T.C.A. Super Constellations. Since you went to press with that issue, moreover, the position has even further improved and, as of September 30, the rate was down to 0.81 per 1,000 hr.

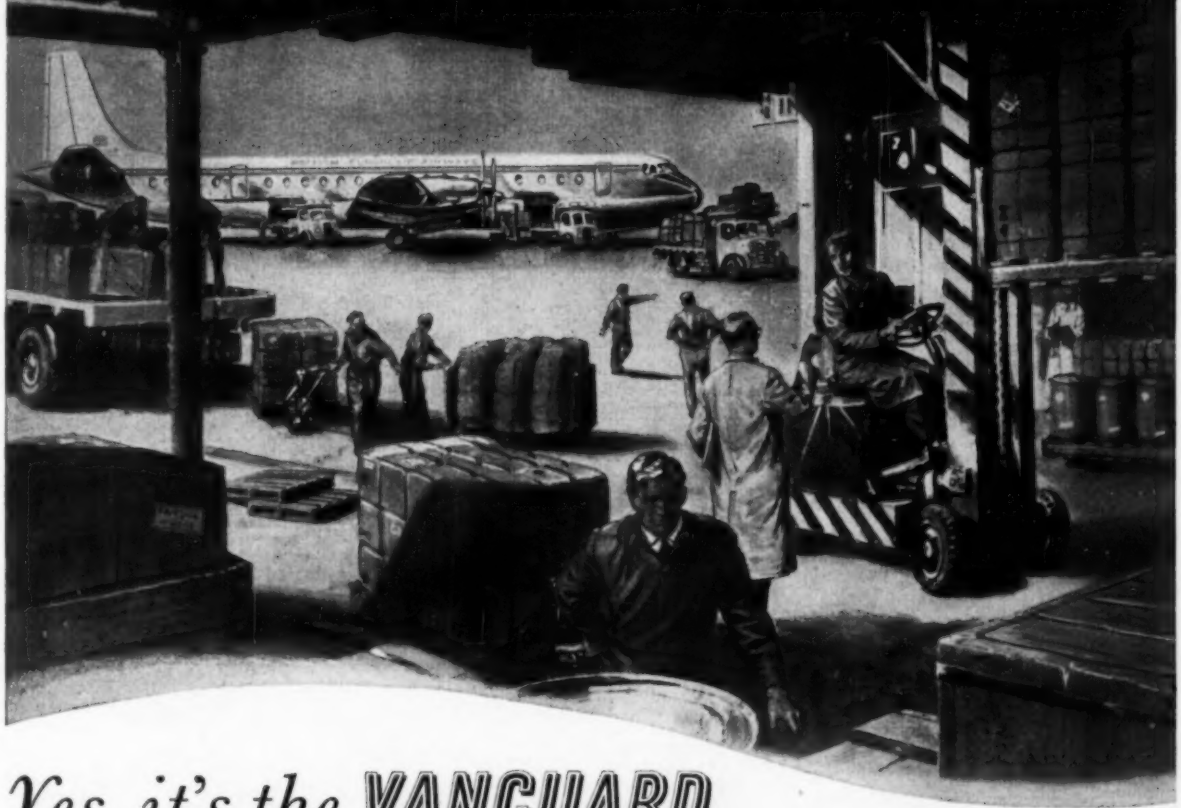
"On the score of overhaul life, you stated that the Proteus entered service in February last at 650 hr between overhauls. In fact it entered service at 500 hr and thus its rapid clearance to 1,050 hr by September 18 is, I think you will agree, even the more meritorious."

THE FIRST INDEPENDENT VISCOUNTS

THE impression given in an article in last week's issue that Transair were the first British independent to introduce Viscounts into service has brought a gentle reproof from Hunting-Clan Air Transport. Although this airline was obliged by circumstances to lease its three Viscount 732s to Middle East Airlines in September 1955, they did, in fact, operate these Viscounts for some four months—starting at the end of May, 1955—on scheduled passenger services based on London and Newcastle.

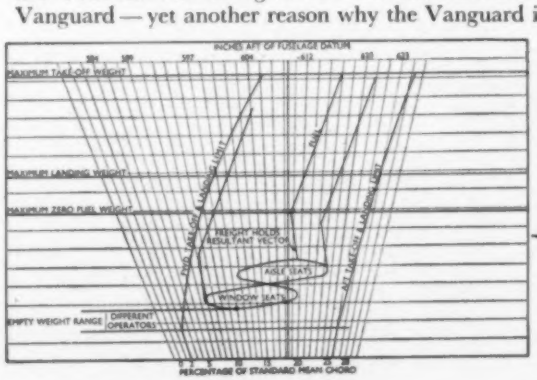
The three Viscount 732s have now been returned by Middle East Airlines, and Hunting-Clan hope to introduce them on to their African Colonial-coach services in the near future. The aircraft are at present undergoing a Check 4 overhaul and, fitted as 53-seaters, they will take over completely from Vikings the thrift-fare services to East and Central Africa. In due course, tourist-class Viscount services to West Africa may be foreseen.

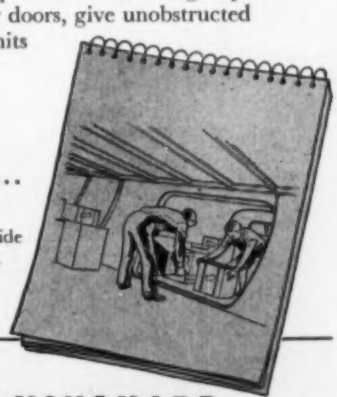
All this FREIGHT from a PASSENGER aircraft?



Yes, it's the VANGUARD

The ability to carry up to 120 passengers or ten tons of freight (density 15 lb. per cubic foot), will ensure profitable operation of the VANGUARD, winter and summer, day and night — even when passenger traffic is at its lowest ebb. With a combined capacity of 1,360 cubic feet, the two spacious holds in the 'double-deck' fuselage give ample room to arrange the freight conveniently in separate destination groups. The exceptionally wide freight doors, situated on the side opposite the passenger doors, give unobstructed access for simultaneous loading and unloading. The very wide C.G. range permits maximum flexibility of passenger and cargo loading. The 'loading loop' below shows the ideal matching of the C.G. limits which is possible with the Vanguard — yet another reason why the Vanguard is the airline's airliner.





For your notebook...

Each freight hold has an unobstructed access 5ft. 6in. wide and 3ft. 10in. projected height. Headroom inside is 4ft. 3in.

VICKERS VANGUARD

Four Rolls-Royce Tyne Propeller-Turbine Engines

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

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The Coin may be different but...

the Service is the same

As Air Travel reaches out to all the countries of the world, so must the services which keep the aircraft flying. The BP Aviation Service is international; at hundreds of different airfields it supplies the essential fuelling and other services on which modern Air Travel depends.

AVIATION BP SERVICE

The international aircraft fuelling organisation of
The British Petroleum Company Limited

Speculation about Herald orders from Australia was renewed when, recently, the Director-General of Civil Aviation, Mr. Donald Anderson, visited Handley Page Reading to inspect and fly in the aircraft. He is seen here (right) with Sir Frederick Handley Page. (News-item on this page.)

CIVIL AVIATION . . .

AUSTRALIA AND THE HERALD

EVER since the Handley Page Herald was announced in 1954, there has been Australian interest in the aeroplane. The first "letters of intent to purchase" came from Queensland Airlines and from A.N.A., involving 29 Heralds, and though these orders have never been confirmed, they still appear to be in prospect. Mr. Donald Anderson, Australia's Director-General of Civil Aviation, has recently observed: "We think the airliner is a first-class prospect, especially fitted with the Dart engines." This remark tallies with one made last May by G/C. R. C. M. Collard, H.P.'s sales manager, when he announced the Dart Herald. "It is not simply turbines that operators are interested in," he said, "it is the Rolls-Royce Dart." He added that Queensland Airlines and A.N.A. had both stated in so many words: "We want Heralds, but we would prefer them with Darts."

The Australian D.G.C.A. called on Handley Page Reading during his visit to Britain (see photograph), and flew in the second (Leonides-powered) Herald. He had previously said that Australian airlines needed to replace 62 DC-3s, and that "if we place an order for the Herald, it would probably be completed over the next ten years." This recalls the remark of the Australian Prime Minister, Mr. Menzies (recorded in a recent issue), that rather than build bigger airports, he would encourage operators to "buy modern pressurized aircraft such as the Handley Page Herald or the Fokker Friendship which would be able to use existing airports."

Because other manufacturers besides Handley Page—particularly those selling medium-haul jets and turboprops—are looking hopefully towards Australia, it might be timely to tidy up the confusing domestic airline situation there, and also the transport-ordering position.

Australian National Airways, although recently bought by Ansett, are likely to operate independently, but there seems certain to be standardization of equipment. This standardization may extend also to Butler (50 per cent of whose shares are owned by Ansett following their purchase of A.N.A.) and to Queensland Airlines, who are wholly controlled by Butler. Thus, so far as new aircraft orders are concerned, two main prospective Australian domestic customers emerge—Ansett-A.N.A., and T.A.A. In addition, Butler and Queensland are likely to be influenced in their equipment programmes by whatever Ansett-A.N.A. do.

It was recently reported in *Aviation Daily* that A.N.A. are now interested in Friendships—presumably in order to match the Friendships ordered by their nationalized rival, T.A.A., which are due for delivery early in 1959. But A.N.A. would not get Friendship deliveries much before the end of 1959—and Handley Page are offering to deliver Dart Heralds before the end of 1958. Thus A.N.A. may be considered a hopeful Herald prospect—and likewise Butler and Queensland Airlines if, as seems likely, they follow in the A.N.A. and Ansett "DC-3 replacement" footsteps.

Ansett-A.N.A.'s recent decision to order four Lockheed Electras appears to settle their medium-haul programme (their rivals, T.A.A., are still deciding between Caravelles, Electras and Vanguards). But the Ansett purchase of eight Convair Metropolitans does not necessarily shape that airline's short-haul programme: Mr. Ansett has expressed his interest in the purchase of Viscounts—either new, or from T.A.A. in exchange for DC-6Bs.

To sum up, manufacturers are looking to Australia to see: (1) Whether Ansett-A.N.A. and their associates will buy Friendships or Dart Heralds; (2) whether Ansett and A.N.A. will buy Viscounts (Butler, of course, already have two) or will stick to Metropolitans; and (3) whether T.A.A. will buy Caravelles, Electras or Vanguards.

BREVITIES

A BOEING KC-135 military tanker fuselage, similar to that now in production for commercial 707s, has completed "nearly 100,000 miles" (presumably about 200 hr) of simulated flight in underwater pressurization tests. Target for underwater tests is to be a flight time equivalent to 150,000 hr.

* * *

The Brazilian airline, VASP, is reported to be interested in buying six Fokker Friendships.

* * *

On October 1 PanAm opened a direct non-stop service from New York with DC-7Cs to Rome.

* * *

Aden Airways, a B.O.A.C. associate, are to operate new DC-3 services to Bahrain and Mombasa.

* * *

The first-ever non-stop flight from Los Angeles to London *via* the Polar route was completed by a T.W.A. L.1649A at London Airport on September 30. The inaugural service took 18 hr 32 min.

* * *

Capt. Gordon Store of B.O.A.C.'s DC-7C fleet will command the Royal flight to Canada, which is due to leave London Airport at 7 a.m. on October 12, arriving in Ottawa 13½ hours later.

* * *

The possibility that the Italian airline Alitalia-L.A.I. may order Caravelles may be inferred from Fiat's licence to build sub-assemblies for the Sud-Est jet transport, and from American reports that the Italian airline is strongly interested.

* * *

Lord Douglas, B.E.A.'s chairman, said on September 30 that tourist traffic between Britain and Switzerland had been "well below expectations." He has been discussing in Geneva plans for a reduction of services between the two countries.

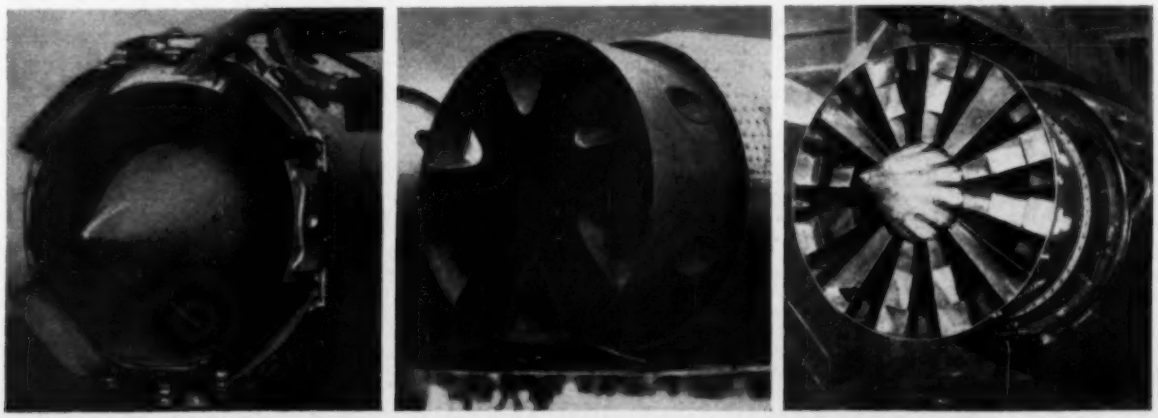
* * *

New routes between the U.S. and Brazil were discussed on September 20 by the two countries. Brazil is reported to want permission for a third Brazilian airline to land in the U.S. and to want a route from New Orleans to San Francisco or Los Angeles *en route* to Japan. American airlines want similar rights in Brazil.

* * *

The de Havilland Aircraft and Propeller Companies say that they have assured B.E.A. of their intention to continue the supply of airframe and propeller spare parts, as well as technical information and service, to operators who may purchase Ambassadors from the Corporation. So far Butler have bought three, and B.K.S. three. The Bristol Engine Company have given a similar undertaking in respect of the Bristol Centaurus engines.

Three ways of doing the same thing: left to right, jet noise suppressors for the Douglas DC-8 (J57), de Havilland Comet 3 (RA. 29), and Boeing 707 (J57). The Comet and 707 equipment conform to the Greatrex (Rolls-Royce) principle; the Douglas device has pneumatically operated vanes, seen here in the position which, according to the Douglas explanation, "causes the exhaust to mix more rapidly with the cool surrounding air."



CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

The R.Ae.S. and Veteran Aircraft

I HAVE read with no little interest the letter of "Ichabod" [October 4] and would agree that the veteran aircraft ought to be maintained in good order.

I agree that to possess the aircraft is not enough, but there have been some difficulties unknown to your correspondent. As I am aware of the proverb which speaks of "excusing" and "accusing," I do not intend to catalogue all the difficulties.

All the Society's aircraft will be housed, in the immediate future, in a hangar, to which, I hope, access will be given. It is my hope that a maintenance squad will be formed, with the specific purpose of maintaining the aircraft until they are handed over to the National Aeronautical Museum.

The ground over which "Ichabod" has sown his seed is not stony, for it has already been ploughed.

London, W.1. A. M. BALLANTYNE,
Secretary, the Royal Aeronautical Society.

Underneath the Arches

THE letter from Mr. Maurice Austin, under the above heading, immediately brought to mind the late Sir Francis McClean's flight up the Thames and under the arches of four bridges after having first flown between the upper and lower spans of Tower Bridge.

One of our national newspapers had arranged for a Frenchman, Lt. de Conneau, to fly a seaplane from France and land on the Thames and, on August 10, 1912, a large crowd and all the Press assembled on the banks to watch this event. Mr. F. K. McClean, as he then was, had the idea that anything the French could do he could do better and, armed with a Short Seaplane, took off from Harty Ferry, Isle of Sheppey, at 6.30 a.m. Having negotiated Tower Bridge he flew into a battery of Press cameras, all poised for the arrival of the Frenchman, and then under London Bridge, Southwark Bridge, Blackfriars Bridge and Waterloo Bridge, to land at Westminster at about 8 a.m.

After the police had made enquiries as to how long Mr. McClean proposed leaving his machine on the water he taxied down the river to below Tower Bridge and took off for his return flight. In turning at about 50ft he stalled and broke a float on hitting the water, which necessitated the machine being dismantled for its return to Sheppey.

This was the first time that an aircraft had flown under a bridge in this country.

While on this topic one wonders if there was ever any truth in the stories of the "Mad Majors" of the 1914-18 war who were supposed to have flown through open hangars unscathed, and whether there is any photographic evidence of these escapades.

Hounslow, Middx. H. F. COWLEY.

MAY I call attention to what I consider the finest book on air warfare that will ever be written, namely F/L. Richard Hillary's *The Last Enemy*? On page 80 of the edition in my proud possession the author gives an extremely graphic account of flying a Spitfire under a bridge situated somewhere on the Severn. This was before he was posted to 603 Squadron at Turnhouse, just before the Battle of Britain.

Letchworth, Herts. R. CROSS.

The First Inverted Loop

IN reply to Mr. Patrick Johnson's letter (September 20) I am certain that he can justly claim to be the first man to do an inverted loop in a light aircraft (as distinct from a "bunted" loop with a roll off the top). Mr. Johnson is also quite correct about Pégoud. According to R. Dallas Brett's (Vol. 2) "History of British Aviation," Pégoud did a bunt on September 1, 1913, in a Blériot monoplane. It took the form of a large vertical "S" in the sky. Perhaps Mr. Johnson would be amused to know that on October 29, 1950, as a passenger in an R.A.F. de Havilland Chipmunk I enjoyed half-an-hour's aerobatics which included the lot—except an inverted loop ! Now, at the age of 53, I have ambitions to fly at over 40,000ft in a jet.

Birmingham 14. MAURICE AUSTIN.

THE INDUSTRY

Transistor Production

ON Tuesday of last week the new transistor factory of Texas Instruments, Ltd., at Bedford, was formally opened by Capt. Christopher Soames, Parliamentary and Financial Secretary to the Admiralty and M.P. for Bedford. Among those present at the ceremony were Mr. Pat Haggerty, executive vice-president of the American parent organization, Texas Instruments, Inc.; Mr. Dudley Saward, the British company's managing director (on whose R.A.F. and civil aviation career a note was published in *Flight* for September 20); and Ald. A. A. Jones, the Mayor of Bedford. The plant is already in production with silicon transistors; on the process, an interesting one, we hope to publish a note in the near future.

Northern Aluminium Appointments

SEVERAL new appointments have been announced in the sales department of the Northern Aluminium Co., Ltd. Mr. E. D. Robinson, formerly assistant manager of the London area sales office, is now area sales manager in charge of the Manchester office (where he succeeds Mr. D. A. Corbett-Thompson, whose appointment as sales manager in charge of export sales was announced earlier). Mr. M. Bridgewater, who was previously in charge of the building and construction section of the sales development division and has just completed a year's study at the Centre d'Etudes Industrielles at Geneva, is now manager of the Northern Aluminium sales development division at Banbury. He succeeds Mr. E. D. Iliff, who (as already announced) has been appointed sales manager in charge of sales development, advertising and publicity.

Hadfields Changes

FOLLOWING the departure of J. R. Rait, D.Sc., Ph.D., A.R.T.C., from Hadfields, Ltd., to take up a new appointment as joint managing director of Briton Ferry Steel Co.—leaving Hadfields, as the company puts it, "with our grateful thanks for the good work he has done for us and our very best wishes for his future success"—his place as research controller has been filled by T. H. Arnold, M.B.E., F.I.M. Mr. Arnold has also been made a local director of Hadfields, Ltd., and appointed to the Board of Hadfields Steels, Ltd., and Hadfields Forgings, Ltd.

L. G. Finch, B.Met., Ph.D., has been made deputy research controller; and the company further announce that Mr. D. R. Eastwood, M.I.Mech.E., M.I.E.E., deputy chief engineer, has been appointed a local director of Hadfields, Ltd., and director of Hadfields Foundry and Engineering Co., Ltd.

Mr. S. Leetch, M.C., who joined the parent firm in 1946 as steel-foundry controller and later became local director and works controller, has now retired.

IN BRIEF

Mr. James Annandale, D.F.C., A.M.I.E.E., has been appointed a director of Partridge, Wilson and Co., Ltd. He has been with them for over 25 years, latterly as sales manager.

* * *

Mr. Harold Caplan, D.C.Ae., A.F.R.Ae.S., A.M.I.Mech.E., has been appointed chief technical officer of the air safety and survey division of the British Aviation Insurance Co, Ltd., following the resignation of Mr. Anderson.

* * *

Mr. William M. Looman has severed his connection with British Plywood Manufacturers, Ltd., and London Plywood and Timber Co., Ltd., and in association with Spark Alloys, Ltd., has established a new company under the title of W. M. Looman and Co., Ltd., as plywood and veneer importers.

* * *

The 1956 Brabazon Premium for the most outstanding contribution on radio and electronic devices for aircraft safety has been awarded by the British Institution of Radio Engineers to Mr. K. E. Harris, technical director of Cossor Radar and Electronics, Ltd., for his paper on *Some Problems of Secondary Surveillance Radar*.

* * *

Information on Nyvin cable from Rists Wires and Cables, Ltd., Lower Milehouse Lane, Newcastle, Staffs, states that this is a light-weight cable of small cross-section, possessing high resistance to damage from oils and fuels and good abrasion resistance, with the ability to operate at temperatures up to 90 deg C. It is to be covered by a new British Standards specification.

ROLLS-ROYCE

AVON

turbo jets power the

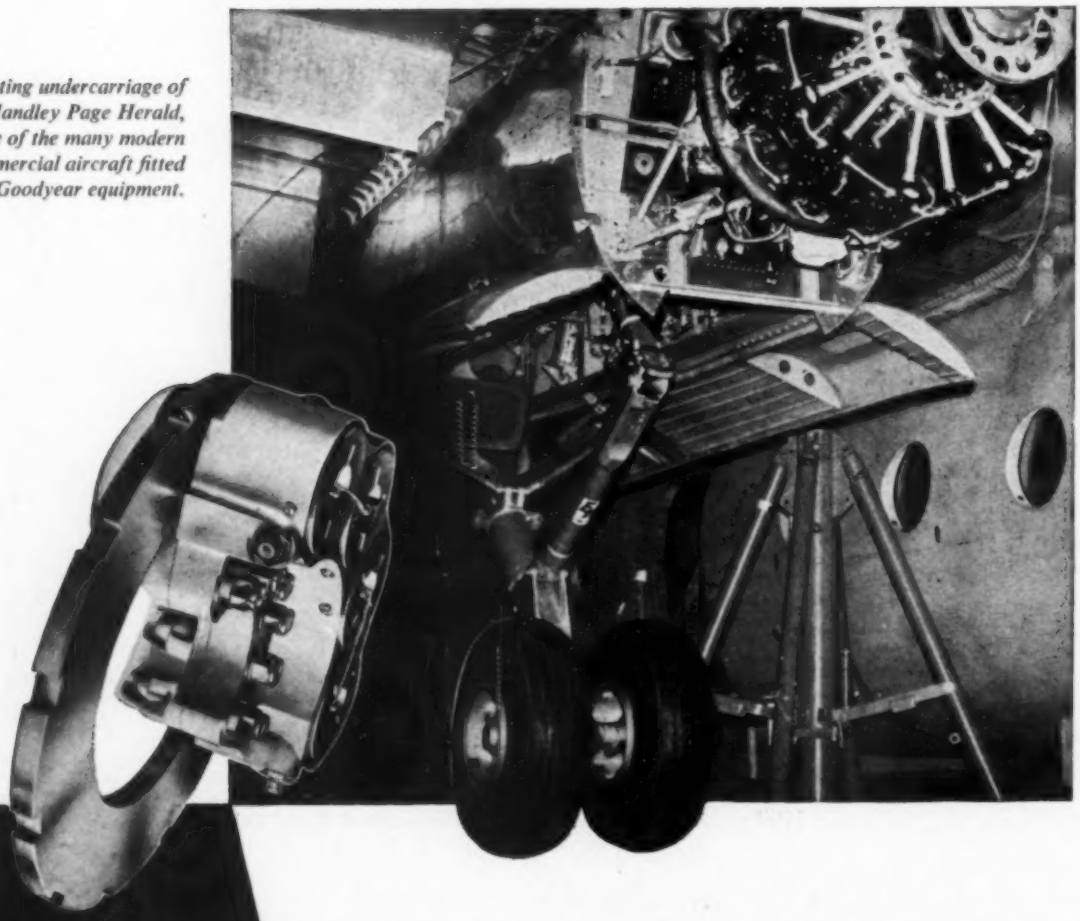
HUNTER FI, F4 AND F6	ENGLISH ELECTRIC P.IB
HUNTER T.MK.7	DRAKEN
SWIFT	LANSEN
SCIMITAR	SEA VIXEN
VALIANT	COMET 2, 3 AND 4
COMMONWEALTH SABRE	CARAVELLE
CANBERRA	FAIREY DELTA 2

RYAN X-13

ROLLS-ROYCE LIMITED

ENGLAND · SCOTLAND · CANADA · AUSTRALIA

Testing undercarriage of Handley Page Herald, one of the many modern commercial aircraft fitted with Goodyear equipment.



GOODYEAR EQUIPMENT STANDARD FOR *Heralds*

Goodyear are sole suppliers of tyres, wheels, brakes, brake controls and anti-skid systems for the Herald. The equipment is designed to give exceptionally long, trouble-free service under the arduous operating conditions for which a versatile aircraft like the Herald is intended.

The ability of the equipment to withstand severe overloads was demonstrated by tests during which a brake made thirty-one emergency stops without change of disc. (The A.R.B. minimum requirement is one stop.)

Eighteen months of field trials and test flying have shown that for reliable operation, efficiency and ease of maintenance, the Goodyear equipment will stand up to the hard usage and high utilization which operators will demand of the Herald.

GOODYEAR AVIATION PRODUCTS

TYRES · WHEELS · BRAKES · ANTI-SKID SYSTEMS

THE GOODYEAR TYRE & RUBBER CO. (GREAT BRITAIN) LIMITED
AVIATION DIVISION · WOLVERHAMPTON

ROLLS-ROYCE AVON 200 SERIES

Recent Developments in a Line of High-performance Turbojets

WELL over 1,000,000 hours' running time has now been accumulated by Rolls-Royce Avon turbojets of all marks in fighters, bombers and airliners in almost every part of the world. Thus there is a very wide background of military experience to support the latest civil variant, the RA.29, which was type-tested to A.R.B. and C.A.A. requirements in March this year and received its A.R.B. certificate in May. A 200-series engine with afterburner powers the Fairey Delta 2 and has attained supersonic speeds equivalent to Mach 1.7. Licences for production of the 200 series are being exercised by Belgium and Sweden; and similar engines power the two American Ryan X-13 tail-sitting VTO machines. Powered by RA.26s, the French Caravelle completed its first 1,000 hours' test-flying some 300 days ahead of schedule and the Comet 3 made its world-circling flight. During its recent two-month tour of the United States the Caravelle was not once delayed by unserviceability.

A comprehensive account of early Avon development, up to the introduction of the 200 series, was given in *Flight* for December 16, 1955. The 100 series led from the RA.3 to the RA.7 and its civil offshoots, the 502 and 503, the last-named being a 7,100 lb-thrust version of the RA.25 destined for the original Comet 2s. The RA.21 of 8,000 lb-thrust was also in the same series.

The 200 story began in 1951 with the design and bench-testing of the RA.14 of 9,500 lb-thrust. This unit included a new compressor and the can-annular combustion system which characterizes all later Avons. The RA.14 served mainly as a development model and is now extinct. Its place has been taken primarily by the military RA.28 which, with a rating of 10,000 lb, powers most of those military aircraft which are now being fitted with Avons. A civil counterpart, designated RA.26, was developed for the early Comet 3 and the Caravelle, but still further work has been done to produce a different engine for the Comet and the Caravelle, and this is the 10,500 lb RA.29.

The RA.29 differs from the RA.28 in many ways; and although few internal details are yet officially released, it can be seen to have a greater number of compressor stages and a different compressor structure. It is stated that the RA.29 has a very high mass flow, with a higher compression ratio, operates at extremely low temperatures and has a three-stage turbine. The rear of the compressor and the compressor outlet are enclosed in a single steel fabrication.

And development of the Avon series goes on: a type-test rating of 11,250 lb has been given for the RA.24, but little information has been released except that it is a "hot" military engine to which an afterburner has been applied.

A particularly noteworthy Avon 200 application is the use, mentioned above, of the RA.28 to power the two Ryan X-13 tail-sitters. The engine was chosen because at the time it was the most reliable in this class; and because it offered a better power/weight ratio and excellent acceleration. Reliability was, of course, also a prime consideration. Rolls-Royce had to incorporate modifications in the lubrication system to allow for vertical running; and some changes were also made to the fuel system. All development was done on one engine and a total of half a dozen were shipped to America. It is also worth recording that an Avon of this series has been calibrated in the N.A.C.A. Lewis Flight Propulsion Laboratory at Cleveland, Ohio, up to very high simulated altitudes.

Though there is still a distinct family resemblance between Avons of the 100 and 200 series, the latter is in fact regarded as a completely new engine. The mounting arrangements, layout of ancillary drives and tail cone are broadly the same, but the compressor is completely new and the early individual flame-can combustion system has been replaced by the can-annular system.

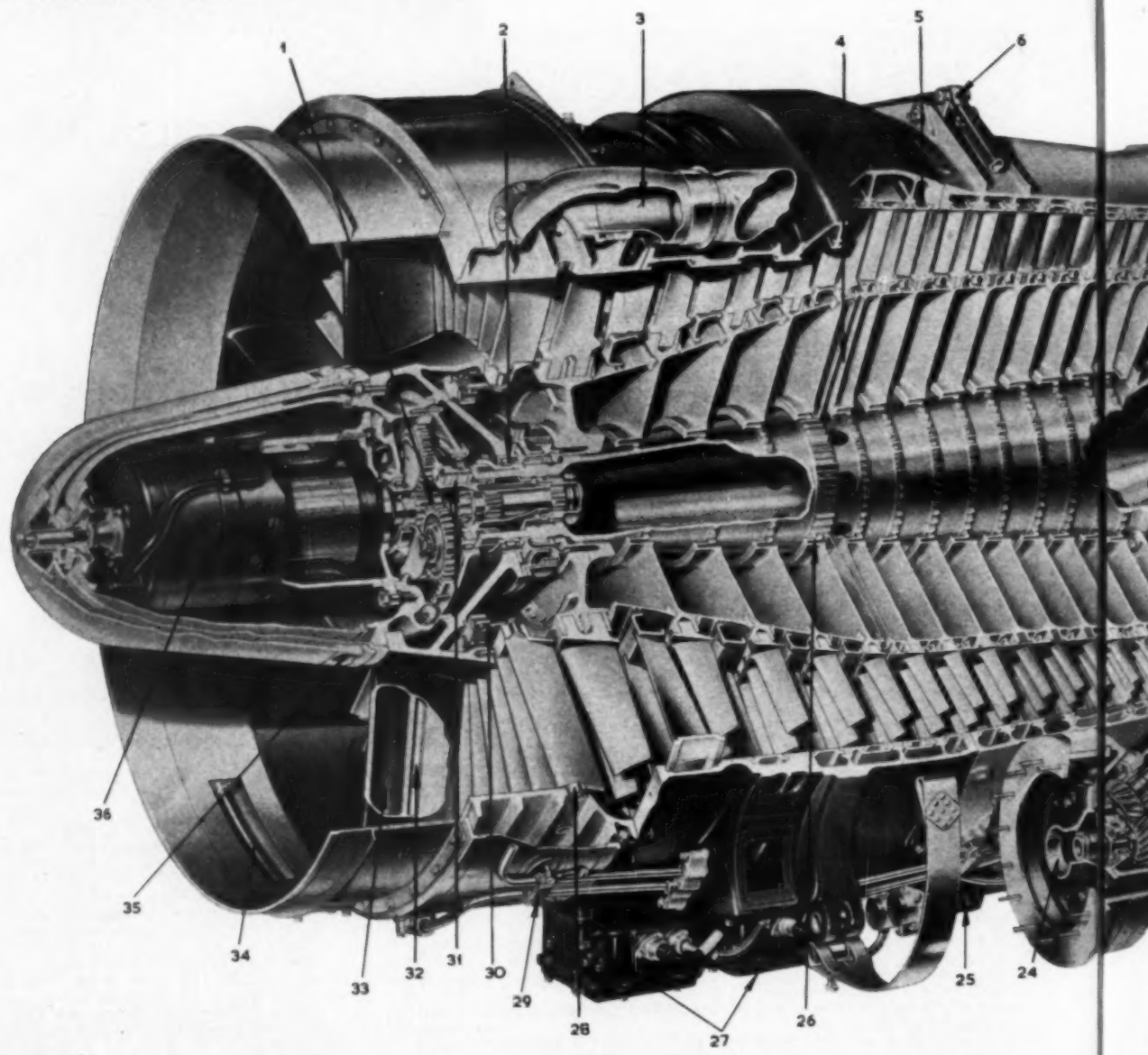
In each mark of the series a number of variants were produced for different installations (bomber, fighter or airliner), but a comparison between equivalent engines in each series shows the following advances. For only detailed dimensional differences, the 200 series has 15 compressor stages instead of the 12 of the earlier engine; mass flow is increased by 30 per cent; compression ratio is up by almost 23 per cent; efficiency at the design point (i.e., at full power) is up by 3 per cent; but maximum r.p.m., at 8,000, are 150 r.p.m. lower than in the early series. The s.f.c. of the RA.28 is 0.86 lb/lb thrust/hr at sea-level take-off setting; and the specific weight of the latter engine shows an 8.5 per cent improvement over the early series.

A Rolls-Royce Avon RA.29, representing the civil development of the 200 series, as supplied for installation in the Comet or Caravelle.

The rotating assembly of the RA.28 consists of a single shaft made up in three main sections and supported on roller bearings at front and rear ends and by a ball bearing in the centre (immediately aft of the compressor). This ball bearing takes residual end-loads, and in fact provides the sole axial location for the shaft. The fixed structure at this point, the very large cast-magnesium front-bearing housing forms the complete intake annulus and supports the starter in its bullet, the forward shaft bearing and the movable inlet guide vanes. These vanes and all forward facing sections of the intake structure have hot air anti-icing arrangements. Directly bolted to the rear face of this casting are the two halves of the forward compressor casing (also cast in magnesium) which cover the first seven compressor stages and house the seventh-stage compressor-bleed manifold. Bolted to this in turn are the two halves of the aluminium rear compressor casing, which includes the flanges carrying the forward engine steady. From this point aft, the main fixed structure of the engine is the intermediate casing, which runs from the compressor outlet casing to the rear bearing housing. Aft of this is the nozzle-box structure, to which the largely unstressed exhaust nozzle structure is flange-bolted. Sheet steel casings form the walls of the combustion section. The main engine bearer trunnions are located at each side of the combustion section, level with the junction between the combustion casing and nozzle box.

Transition between the after end of the compressor case and the forward end of the combustion area is effected by a very large light alloy casting, a complex of manifolds and air passages. Produced by Rolls-Royce, it is rightly regarded as something of a triumph in the casting art. From this component the anti-icing and cabin pressurization air is bled off.

The compressor includes an air-bleed system at the seventh stage which serves to reduce the stress on the blades at low power-settings. Both the opening of the gate valve which controls the



ROLLS-ROYCE AVON 200 SERIES . . .

seventh stage bleed and the variation of inlet guide vane angle are controlled by rams operated by fuel pressure.

A shaft drive is taken horizontally to each side of the engine by a gear system driven directly by the main rotating shaft from a point just aft of the centre bearing. The drive to the right-hand side of the engine is primarily intended for the lubrication and fuel-pump systems, while that to the left serves other accessories such as generator drives. Variously in individual installations, these drives are used to serve generators or alternators, or to provide power for an ancillary gear box mounted as part of the airframe. In the cut-away drawing, above, the port side drive is arranged to serve a generator or alternator.

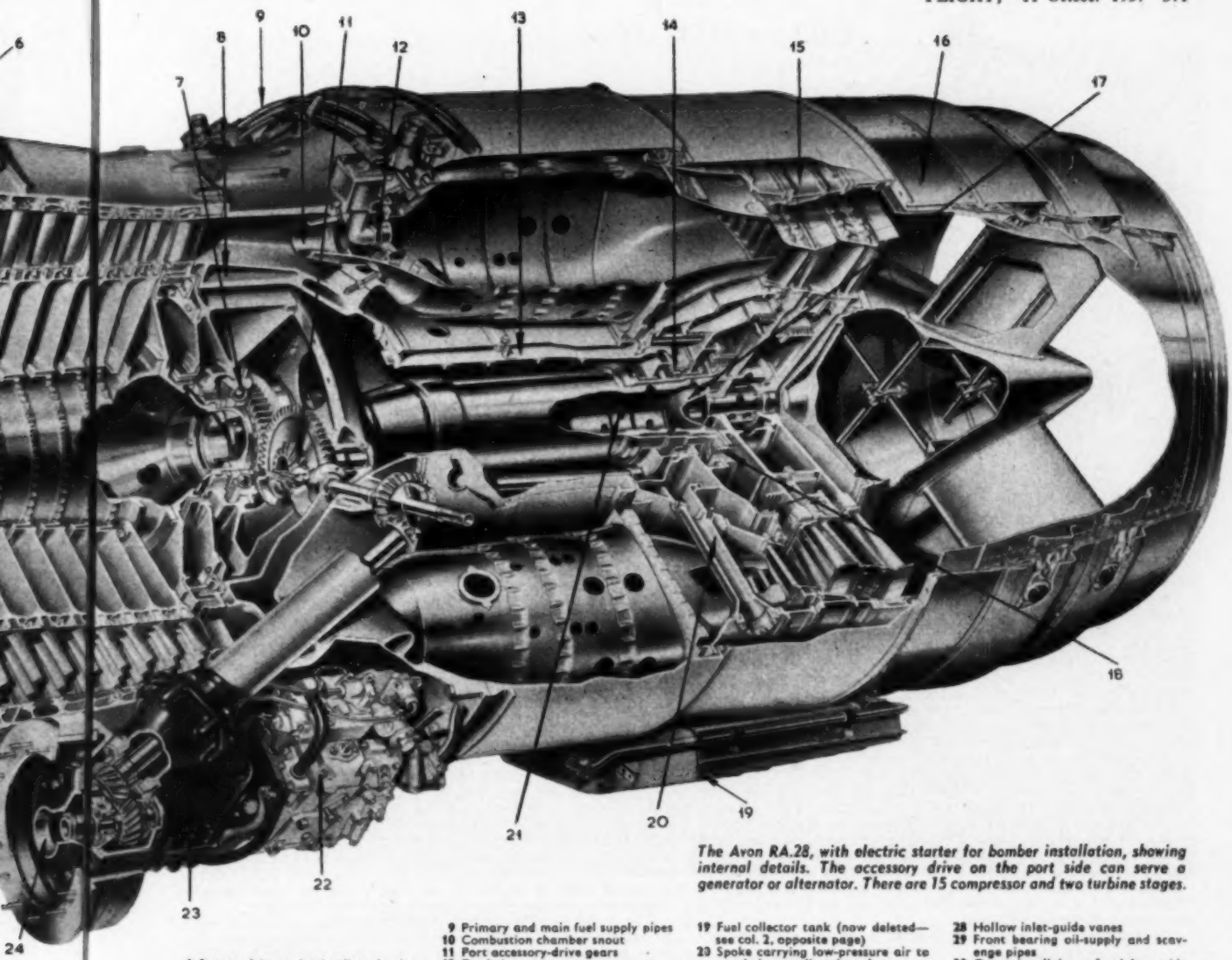
There are two air-bleed systems, low pressure and high pressure, to serve oil sealing, cooling and the pressure balancing and air-sealing of the two-stage turbine system. The low-pressure air, bled from the vortex reducer between fifth and sixth compressor stages, cools the bearings and wheel case before being vented to atmosphere *via* the turbine-case cooling manifold. The high-pressure bleed is taken from the secondary air in the combustion system, led through the double wall of the "milk churn" which forms the inner fixed structure in this area, and fed to each face of the two turbine discs. It is then vented into the main efflux by leaking past the turbine blading through seals.

Lubrication of the three main bearings, starter reduction gear and ancillary drive system is provided by a single pump delivering to appropriate galleries, and by five pumps scavenging the bearings and drives. The pumps and filters are mounted in the oil sump itself; and the main delivery flow is cooled by passing through a fuel-cooled oil cooler.

In the accompanying cut-away drawing a small flat tank is shown mounted beneath the turbine section, but this has now been deleted from all RA.28-type engines. It was originally intended to serve as a fuel drain collector tank.

The combustion system consists of eight flame-tubes mounted within the annular chamber, each fitted with a Rolls-Royce duple burner. Nos. 3 and 6 tubes carry high-energy igniters, supplied by appropriate high-tension units mounted under the forward compressor casing. Interconnecting pipes between each pair of flame-cans serve to pass the starting flames to the other six tubes and to balance pressure.

Engine starting may be by electric motor (as shown in the cut-away drawing), by iso-propyl nitrate starter (for fighter aircraft), or by kerosine/air turbine. All three units are mounted on the nose of the compressor.



The Avon RA.28, with electric starter for bomber installation, showing internal details. The accessory drive on the port side can serve a generator or alternator. There are 15 compressor and two turbine stages.

1 Starter drive and epicyclic reduction gear
2 Front bearing (roller)
3 Anti-icing air duct and manifold
4 Vortex-reducer bleed for low-pressure air supply
5 Seventh-stage air bleed
6 Forward engine-steady linkage
7 Centre ball-bearing
8 Anti-icing air collector manifold
9 Primary and main fuel supply pipes
10 Combustion chamber snout
11 Port accessory-drive gears
12 Duple burner
13 Double-walled intermediate casing collecting high-pressure sealing air
14 Rear bearing (roller)
15 Nozzle box and cooling shroud
16 Exhaust unit carrying exhaust cone
17 Blanking plate separating low- and high-pressure air at end of shaft
18 Labyrinth seals (also at front and centre bearings)
19 Fuel collector tank (now deleted—see col. 2, opposite page)
20 Spoke carrying low-pressure air to nozzle box-cooling shroud
21 Rear shaft, showing low-pressure-air orifices
22 Fuel control unit
23 Fuel-cooled oil cooler
24 Alternator or generator drive
25 Ignition low-tension units
26 Turbine-disc mounting spline and hairpin section
27 Ignition high-tension units
28 Hollow inlet-guide vanes
29 Front bearing oil-supply and scavenge pipes
30 Operating linkage for inlet guide vanes
31 Pawl and ratchet starter drive
32 Front bearing oil-supply pipe
33 Anti-icing air passage
34 Intake-temperature sensing unit
35 Starter fairing anti-icing air outlets
36 Electric starter motor; alternatives are iso-propyl nitrate or kerosine/air turbine

The following detailed description of the Avon RA.28 follows the structure through from the forward end to the rear. The engine is in fact built up vertically on the production line, standing on its intake casing. The rotating assembly is made up complete and balanced on a separate rig before being offered up; and the compressor halves, complete with stator blading, are closed round it. Remaining sections are then added. Because of space requirements on board aircraft carriers, it has been made possible for the RA.28 to be set up horizontally for repairs, thus avoiding the necessity for the more usual vertical fixtures.

The whole intake structure is formed in one large magnesium casting, the outer ring of which bears a number of circumferential flanges for stiffening. Between two of these lies the ring of bushed holes which accommodate the outer ends of the 43 inlet guide vanes. Three of these, on the lower right side, carry levers linked one to another, one lever also picking up the piston of the angle-varying ram. The ram position is transmitted through these three master blades to levers at their root ends and transmitted to a ring sliding on a diameter on the front bearing housing. Other levers pick up the roots of all the other vanes and transmit the ram position to them.

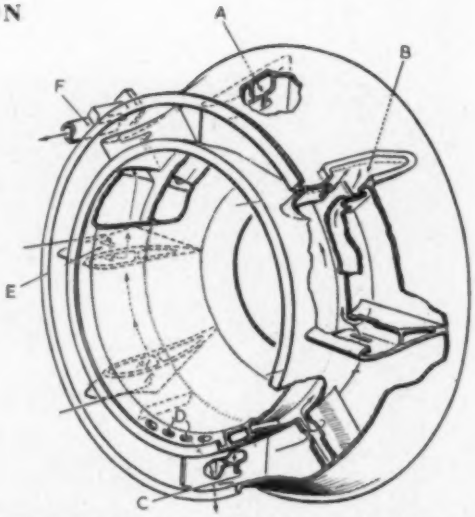
A built-up sheet-steel shroud is mounted outside the intake casing to form a manifold for anti-icing air supplied through a duct from the compressor outlet casing. The front bearing housing itself is carried on six struts, set tangentially rather than radially to allow for expansion; and the anti-icing air is led through passages cast in these to the bearing housing itself. Some of the air also passes through the inlet guide vanes, which are designed as hollow built-up units for this purpose. The anti-icing air is passed forward through the space between the inner two skins of the starter motor fairing. At the forward end of this fairing it turns through 180 deg to flow inside the outer skin and back to the bearing housing, to be vented into the main intake at the rim of the fairing.

The front shaft bearing is carried in the inner face of a cone integrally cast with the intake structure described above. In the recess left forward of this cone, the starter reduction gear housing is bolted in, the starter motor itself being flange-bolted to the housing. The sheet-metal starter fairing is retained by a bolt to the forward end of the motor and rests against the main intake casting and reduction gear housing on two seals.

Starter reduction gearing is of the epicyclic type, the annulus being fixed and the output being taken from the casing holding the planet wheels and transmitted directly to a pawl and ratchet

ROLLS-ROYCE AVON 200 SERIES . . .

The intricate casting which forms the compressor outlet casing. Certain features are annotated in the drawing on the right: A, top and bottom struts slotted aft of dividing wall; B, engine anti-icing air bleed; C, vent to atmosphere, front section of strut; D, seal vent; E, struts (other than upper and lower) slotted forward of dividing wall; F, airframe anti-icing and cabin-pressure air.



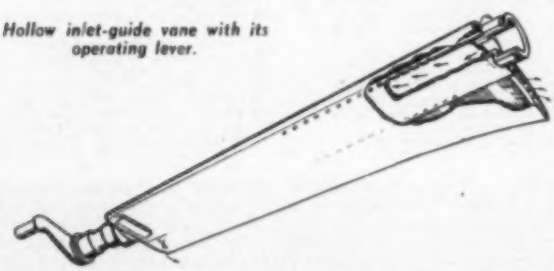
system. This device remains engaged when the engine is stationary and until a predetermined r.p.m. has been reached, whereupon the pawls disengage and the motor is stopped. The torque is transferred by splines to a large bolt housed inside the forward end of the compressor shaft. Drive is transmitted to the inner face of the shaft itself by further splines at the rearward end of the bolt.

A fabricated sheet-metal extension is bolted to the front of the front bearing housing to form the true engine intake. In an open recess in its inner surface it carries a temperature-sensing element which provides indications for the inlet guide vane ram. The oil feed and scavenge pipes for the front bearing and starter reduction gear are led through two passages cast for the purpose in two of the struts of the intake annulus.

As described above, the compressor casing is divided into a forward section (magnesium) and an after part (aluminium alloy), both being split longitudinally into two halves. Each section is flange-bolted to its neighbour, the stator blades being held by tongues in grooves cast into the compressor ribs and machined at the locating diameters. The blades are threaded into each half of the compressor shells before assembly. The forward stages are in aluminium alloy, while the rearward stages, exposed to higher temperatures, are of steel. To prevent fretting at the roots under high loadings, the fourth and fifth and tenth to fifteenth stages are slipped into aluminium-alloy rings which are themselves a tongue-and-groove fitting in the case. End stops are incorporated at the compressor joints to prevent circumferential movement of the stator blades.

In the first four stator stages—that is, in the more sharply

Hollow inlet-guide vane with its operating lever.



tapering section of the compressor—the tips of the stator blades are supported by being brazed in threes, fours or fives to rolled aluminium shrouds which also make a tip seal against flanges on the compressor spacers. At the rear end of the compressor, the stator blades are unsupported at the tips, but are brazed together in groups at the roots.

The bases of the seventh-stage stator blades are cut away so as to leave a rectangular gap between adjacent blade roots; and these provide a passage for the main compressor bleed designed to relieve blade root stresses at lower r.p.m. settings. Air thus escaping is collected in an annular manifold cast round the rear of the forward casing. At the lower engine-power settings, a ram operated by fuel pressure opens a gate valve mounted on the upper starboard side of the manifold to bleed unwanted air to atmosphere. The manifold extends forward over the third, fourth and fifth stator stages. Fuel to open the bleed valve is supplied from the inlet-guide-vane operating system, so that the bleed opens when the vanes reach a certain setting.

Two flanges, cast in the outer surface of the rear section of the compressor casing, provide attachments for the tubular front suspension and its swing links. Further contours are also cast in the compressor surface to accommodate the various engine accessories which are mainly located underneath.

Described earlier in this article as something of a triumph in casting, the compressor outlet casting forms an annular passage for air passing from compressor to combustion section and also provides support for the centre bearing, wheelcase and ancillary drives. In addition it has integrally cast manifolds for anti-icing and pressurizing air bleeds, and provides the forward support for the flame-tubes and their burners.

In the main air passage, eight struts carry the structure loads to the bearing housing. Each strut has two passages cast in it, and slots connecting the foremost of these with the main airflow effect the main bleed for anti-icing and aircraft services. The air passes inwards through most of the struts and is collected in the manifolds cast inside the main casing; but through two struts it flows outwards to the two bleed outlets. The use of the anti-icing system causes a certain reduction in thrust and it is therefore only applied when needed. An electrically operated gate valve is located at the relevant outlet to control the bleed. The top and bottom struts are slotted at the rearward passage to collect bleed air, while other air bled from the seals at the last stator stage is vented direct to atmosphere through the forward passages.

The centre bearing housing is bolted into the compressor outlet casting and holds the central ball bearing which supports the shaft at this point. At the rear is attached a further aluminium plate, carrying the bearings for the two spur wheels which transfer shaft rotation, *via* a helically splined bevel drive, to the two accessory shafts; the bearings of the latter are accommodated in the outlet and wheelcase castings. Primary and main fuel supplies for the burners are taken from the fuel-control unit under the engine direct to the distributer pipes which connect with each burner. The cast aluminium snout of each burner is located by setscrews in the outlet casting; and the burners themselves have their supports in the casing at this point.

Here the structure of the engine is carried by the steel casing inside the combustion section. The outer casing and the intermediate casing, colloquially known as the "milk churn," and made in Fortiweld steel, are thus directly bolted to the inner and outer flanges of the compressor outlet casing and extend aft as far as the end of the flame-tube proper and the beginning of the nozzle section. At this point they are in turn bolted to the rear bearing housing structure and the Crown Max centricast nozzle-box assembly. A sheet steel shield is applied to the intermediate casing to form a double wall inside the air casing through which high-pressure air is bled off to seal the turbine.

Some of the structural loads are transferred from the "milk churn" and rear bearing housing to the outer nozzle casing by hollow radial struts between the flame-tube nozzles. These struts serve also as channels through which low pressure cooling and sealing air, which has passed through and round the main shaft, is transferred to the cooling manifold round the nozzle casing. It is thence vented direct to atmosphere.

Each of the eight flame-tubes consists of four sections, the cast-aluminium snout (mounted in the compressor outlet casing), the flare, the tube and the nozzle, all in sheet Nimonic 75. About eight per cent of the compressor air passes directly into the snout

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ROLLS-ROYCE AVON 200 SERIES . . .

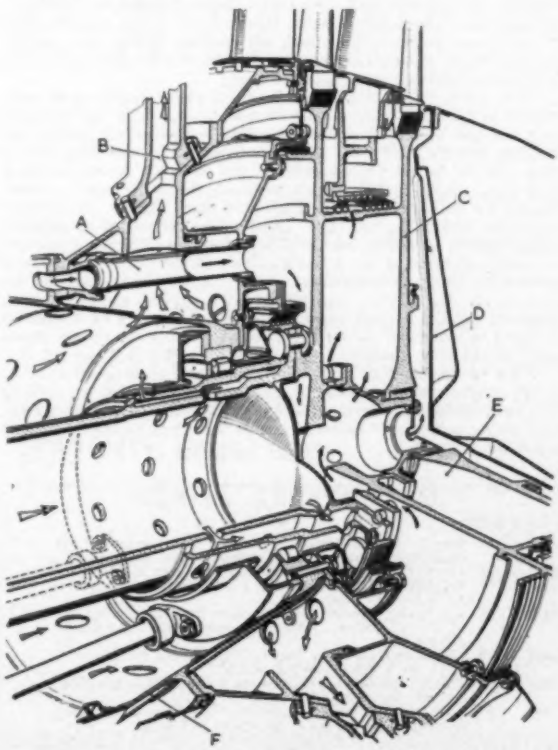
Underside view of a 200 series Avon, showing disposition of accessory drive, ignition units, fuel-cooled oil cooler and fuel control unit.

through the ring of swirler vanes and is mixed with atomized fuel which leaves the burner at this point. Some air also escapes into the double-walled flare section to cool the flame-can before the first secondary air enters the combustion area. The secondary air, passing round the can, is led back into the tube by a series of holes and flutes. Some 25 per cent of the total airflow reaches the primary combustion zone, the remainder being drawn in later so that it first insulates the inner and outer air casings. As stated earlier, the cans are interconnected in order to pass the starting flame round from Nos. 3 and 6 cans, which hold the igniters, and in order to balance the pressures in the cans.

The ends of the flame-tubes and the nozzles, which have a segmental shape, are located by straight double flanges which pick up neighbouring pairs of tubes. Flutes allow a controlled leakage of secondary air between the nozzles for cooling purposes.

Nozzle guide vanes, made in C.242 steel, are located ahead of each stage of the two-stage turbine, the high-pressure guide vanes being mounted between slotted flanges in the outer casing and inner ring. Each vane carries tongues which engage with slots for circumferential location. The low-pressure guide vanes are supported in a similar manner at their outer ends; and the inner ends are located in the ring which carries the interstage seals.

The exhaust unit, which is fabricated in Nimonic 75, is bolted to the nozzle casing and carries the exhaust cone on four radial struts, these being faired to allow a smooth airflow through the exhaust unit. The front face of the exhaust cone forms a sealing plate close against the rear face of the low-pressure turbine, high-pressure sealing air flowing radially between the two to seal the rear of the blade roots. Heat-insulating material is packed between the double skins of the exhaust-unit outer wall.



Rear bearing and turbine assembly (dark arrows indicate h-p. sealing air and light arrows l-p. sealing air): A, one of six h-p. sealing-air tubes; B, low-pressure air outlet through spoke; C, l-p turbine disc; D, insulation plate; E, inter-disc space; F, intermediate casing.

As outlined above, the main rotating assembly consists of a shaft built up in three sections and supported on three bearings. The compressor shaft is a hollow, conical stainless-steel unit which locates and supports the fifteen separate compressor discs on fourteen splines and the fifteenth-stage disc on a flange. In early Avons the splines only transmitted torque to the discs, which were themselves located on flat diameters. All the 200-series discs are forged steel and—except the fifteenth—have a hairpin cross-section at the root to allow expansion without disturbance of the mounting spline. During assembly these discs are simply placed on the shaft in order and a large nut at the front is tightened to retain the stack in position. The resulting end-loads are transferred to the periphery of the discs, spacing rings being interposed to maintain correct separation. The web of the forward discs is considerably enlarged to accommodate the transfer of these loads from hub to disc rim. Blades in the first to eighth compressor stages are of aluminium alloy. From the ninth stage aft they are of stainless steel. In the very latest engines the last four stages are of titanium.

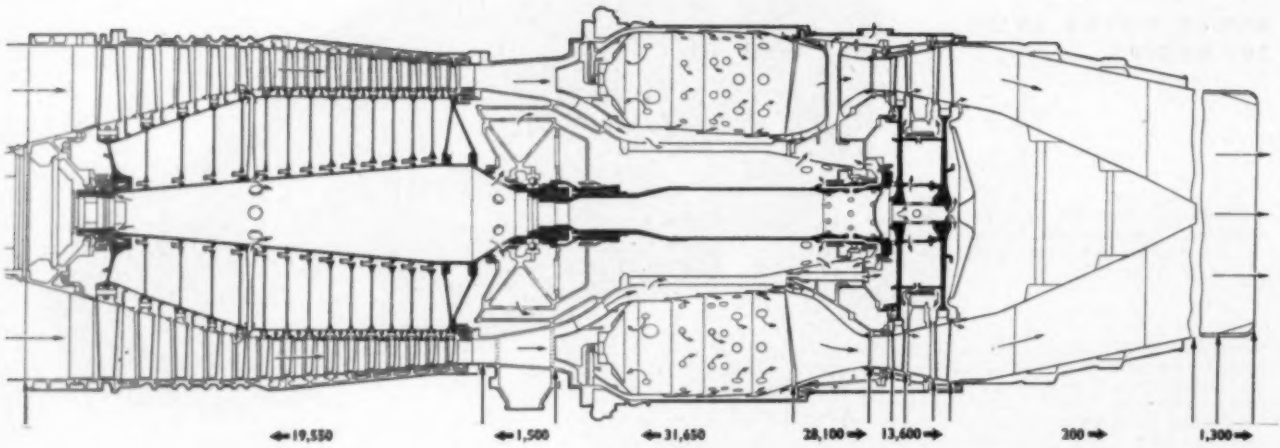
The fifteenth compressor stage blades are located on a disc which is bolted to a flange on the shaft, the whole being further supported in the fore-and-aft sense by another disc which is integral with the cone which picks up the flexible coupling between rear and forward shaft sections, and also carries the centre bearing. Flanges thrown up on the first and fifteenth disc carry balance plugs inserted as required when the rotating assembly is first balance-tested. Further balance plugs can be inserted in a similar flange on the forward face of the high-pressure turbine.

All compressor rotor-blade roots are pin-jointed between flanges in the disc peripheries, the pins having a clearance in the roots so that each blade can rock considerably. Roots on the first four stages are bushed for extra strength and, for the same purpose, the first-stage blades have double fork fittings. In the first five stages, the blade-retaining pins carry heads which prevent forward movement. Rearward movement is precluded by flanges, overlapping the pins, on the spacer rings. The spacer rings in all other stages carry two flanges which positively locate pins without heads.

Air for cooling and sealing is bled through holes in the spacer ring between fifth and sixth compressor stages and passed through a double sheet-steel diaphragm, which prevents vortices, to the compressor shaft. It there passes through holes into the inside of the shaft and provides the low-pressure cooling and sealing air for the whole shaft assembly. Thereafter it travels forward to a series of labyrinth seals round the forward bearing, where it both cools the bearing and prevents oil leaking to the rest of the engine. It does the same at the centre bearing by passing both through the shaft and out to the rear face of the bearing, and also through holes straight to the front of the bearing housing. From here it flows both inside and outside the shaft, within the "milk churn," and does similar work at the rear bearing before passing through the radial nozzle box struts, as described above.

The seals themselves consist of male and female members. The latter are a large number of closely pitched fine grooves in the bore; and the male member has a smaller number of large grooves. When the engine is hot they run with a fine clearance between them.

The centre bearing is actually carried by the cone which forms the support for the fifteenth-stage disc. A ball coupling accom-



Thrust distribution (in lb) and cooling-air diagram for a comparatively early mark in the 200 series, the RA.14. Effective forward thrust is 9,500 lb. Vertical arrows indicate points at which aerodynamic measurements are commonly taken; light arrows show airflow.

ROLLS-ROYCE AVON 200 SERIES . . .

modates the forward end of the turbine shaft; and a screw thread is used to locate the two together and precisely adjust the length of the whole assembly. The splined coupling transmits the torque from turbine to compressor shaft.

Low-pressure air passing inside the rear shaft is deflected outwards through holes in the shaft into the chamber inside the "milk churn" by a blanking plate which seals off the rear end of the shaft. At this point the turbine assembly is bolted to the shaft by appropriate flanges on each unit. The two turbine discs, forged in stainless steel, are held together by a large hollow bolt which is suitably perforated to pass high-pressure air into the space between the two turbine discs. This air is led by pipes from the double wall of the "milk churn" to the front face of the high-pressure turbine disc and thence into the hub through holes in the main attachment flange. Some air then passes between the discs, as previously stated, while the remainder passes right through the bolt and is constrained to pass over the rear face of the low-pressure turbine by the sealing plate on the exhaust cone. All turbine blades have fir-tree root fittings. The high-pressure stage units are in Nimonic 95A and the low-pressure in Nimonic 80A.

Held together by the central bolt, the two turbine discs are located axially by flanges, and torque is transmitted from one to the other by dowels connecting two further flanges which hold the interstage labyrinth seals.

The lubrication system, which works at a pressure of 35 to 40 lb/sq in, differs from that of the 100 series only in having a scavenge pump, instead of a gravity drain, for the centre bearing. This has the effect of metering the leakage of low-pressure air through the seals and preventing the airflow into the sump from overloading the centrifugal breather pump located there. The usable oil capacity is nine pints; and replenishment is from underneath and has to be done under pressure. A sight glass in the wall of the sump indicates oil level.

The right-hand ancillary drive from the engine is turned through 90 deg and led down through what is termed the drive tower, at the bottom of which is the sump containing the six pumps and their filters. Further drives taken from the tower serve the centrifugal breather, the governor pump, the tachometer generator and the fuel pump.

The fuel system is controlled by variations in flow, as opposed to the variations in pressure used on earlier types of Avon; and a proportion of the main engine flow is fed from upstream of the throttle valve and by-passed to the pump inlet. This forms the proportional circuit which controls the main flow under varying conditions of altitude, jet-pipe temperature and engine speed. Pump pressure thus varies directly with engine fuel demand, so that the pump operating pressure at low engine speeds is considerably less than is the case with pressure systems. Since the metering is confined to the small proportional flow, the range of flow control required is much less than it would be if metering were applied directly to the engine main flow. Any undesirable pressure variations downstream of the unit do not affect the flow supply to the engine.

Mounted on the external wheelcase, the high-pressure fuel pump is of the dual type with two multi-piston, variable-swash-plate units directly connected and accommodated in the same case. A hydro-mechanical governor unit is driven by pump-delivery fuel; and the delivery also passes through the fuel-cooled oil cooler.

The throttle and all automatic controlling mechanisms, except the pump governor and servo pistons, are contained in the proportional flow control unit, mounted under the left side of the engine, which varies fuel flow according to power lever position, altitude, j.p.t., r.p.m. and compressor delivery pressure. The unit includes the combined throttle valve and h.p. cock, acceleration-control unit, barometric control, pressurizing valve, j.p.t. datum control, r.p.m. datum control, altitude idling valve, ground idling adjustment and automatic drain valves.

This, then, is the Avon which is the most widely used axial engine in the R.A.F. It is safe to assume that it is the standard unit for the Valiant and Hunter. The Avons which power the English Electric P.1B are of the more powerful afterburning RA.24 type. As for future development of the Avon series—an ultimate power of about 14,000 lb can probably be expected—it seems logical to suppose that the high-mass-flow RA.29 compressor might be wedded to the "hot" combustion section of its military counterparts. Another line of development which was exhibited and demonstrated at the S.B.A.C. Show is the combined silencer and thrust reverser installation which, on the Comet, will be the first to go into service, and will also be applied to the Conway destined for Comet and Boeing 707. The Comet 4 development aircraft, which flew during the S.B.A.C. Show, is already fitted with production silencers.

Thus the Avon bids fair to become almost as ubiquitous as its great reciprocating predecessor, the Merlin. The power of both has been increased by around 100 per cent during their service life and both engines have powered a wide variety of military and civil aircraft.

C.M.L.

FORTHCOMING EVENTS

Oct. 11. Tiger Club: Annual Dinner, R.A.F. Club.
Oct. 14. Institute of Transport: Presidential Address by Sir Reginald H. Wilson, M.Inst.T.
Oct. 16. Institute of Navigation: Annual General Meeting and Presidential Address: "Display and Use of Navigational Intelligence," by Capt. A. M. A. Majendie, M.A., A.F.R.Ae.S., F.I.N.
Oct. 16. Radar Association: "Physics and Radar," by Dr. R. A. Smith, M.A., Ph.D., A.M.I.E.E.
Oct. 16. G.A.P.A.N.: Annual General Meeting.
Oct. 16. R.Ae.S.: Graduates and Students Section: "Trends in Air Transport," by P. W. Brooks, B.Sc.(Eng.), A.C.G.I., A.F.R.Ae.S.
Oct. 16. Kronfeld Club: Film Show given by Betsy Woodward.
Oct. 22. R.Ae.S.: Section Lecture: "Aircraft Instrumentation for Flight-test Purposes," by R. I. Duddy and I. McLaren.
Oct. 23. Kronfeld Club: "Trailer Building," by Tony Goodhart.
Oct. 30. Kronfeld Club: "B.E.A.," by P. W. Brooks, B.Sc.(Eng.), A.C.G.I., A.F.R.Ae.S.
Oct. 31. G.A.P.A.N.: "British Aircraft: Some Designers' Problems," by D. L. Brown, A.M.I.C.E., M.I.Mech.E., M.I.Gas.E., A.F.R.Ae.S.
Nov. 2. British Interplanetary Society: "Conditions for Life," by Dr. J. W. S. Pringle, M.B.E., F.R.S.
Nov. 7. R.Ae.S.: Graduates and Students Section: "Background to Aircraft Specifications," by K. W. Clark.
Nov. 13. Royal United Service Institution: "The Aircraft Designers' Dilemma," by Dr. G. V. Lachmann, F.R.Ae.S.

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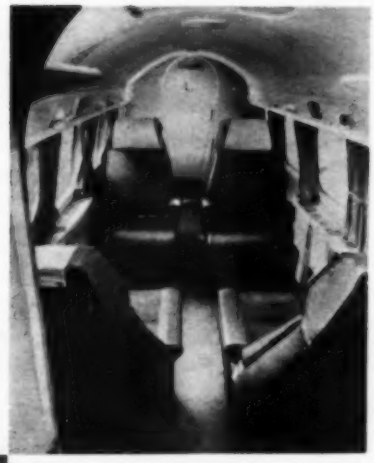

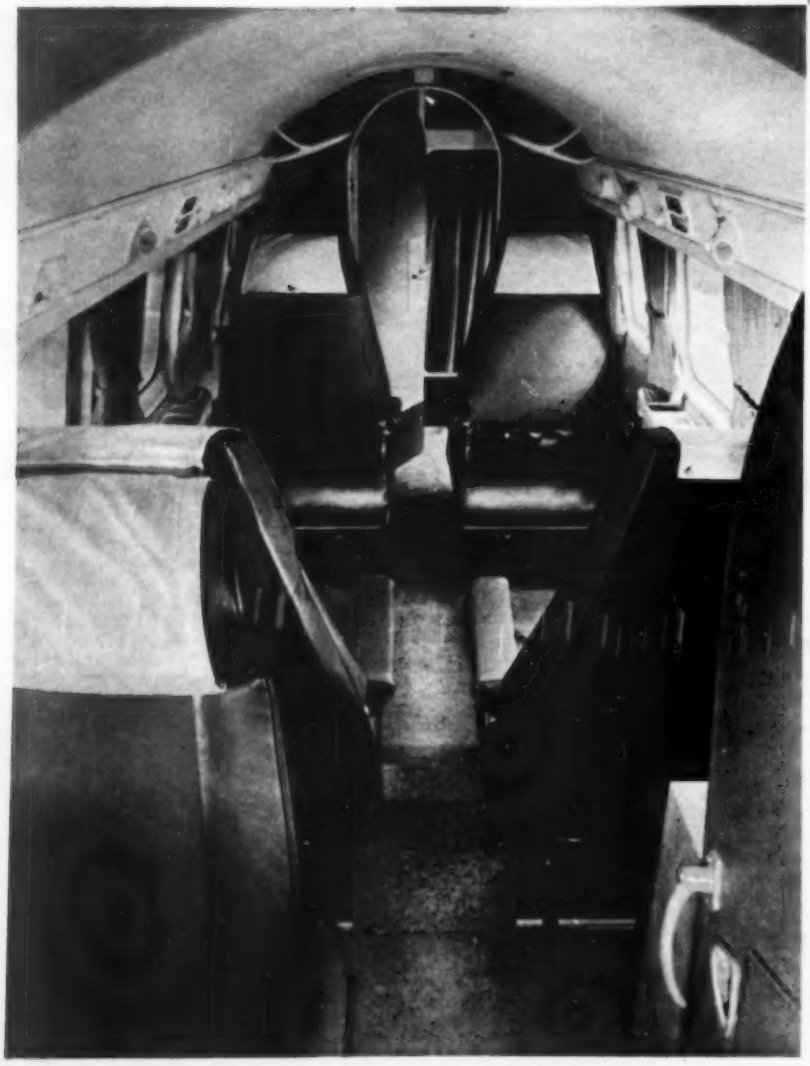

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AEROPLANES FOR THE EXECUTIVE MARKET

THE outstanding impression to be gained from a first glance through the review (pages 578-600) which forms the principal feature of this issue is the wide variety of executive aircraft available in the autumn of 1957. A closer look shows that almost every configuration—singles, twins, multis, two-seaters, four-seaters, and V.I.P.-interior turboprops with gross weights up to 60,000 lb—is represented in the list. Some are conversions of military aircraft, others serve dual rôles as business transports and trainers or, at the other end of the scale, business transports and airliners; new "roadable" aircraft have appeared; and an exciting new range of executive jet contenders—designed primarily for a military rôle but tailored to the needs of business houses with far-flung commitments—is entering the lists for civil honours.

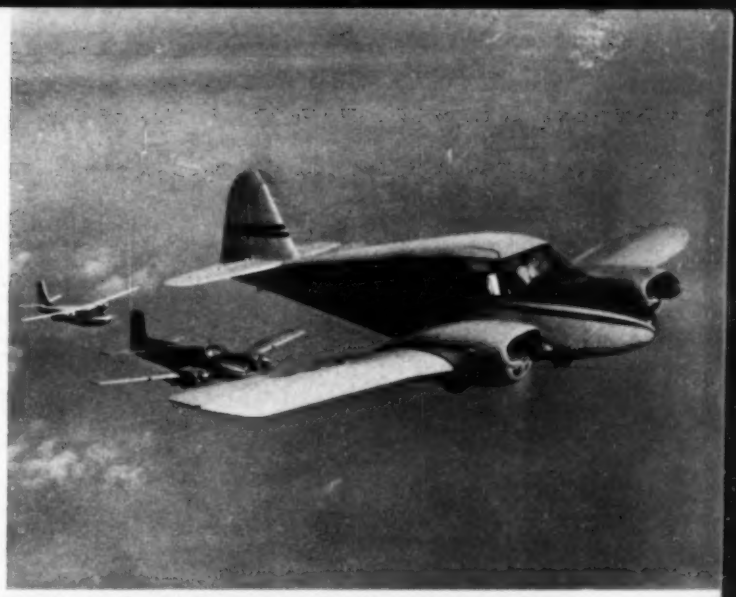
Any examination of this sphere of air transport shows that the U.S.A. has a lead amounting almost to a monopoly. Business flying, it has frequently been pointed out, is related to the gross national product, which is another way of saying the standard of living of the country. But at least the nucleus of a virile business market exists in Europe. For its wider expansion it awaits new aircraft, improved facilities, more settled national economies and an increased acceptance of the advantages in prestige and convenience that a business aeroplane can bring. Although geographical reasons may militate to some extent against a very broad expansion in Great Britain, prospects of a European Common Market should bring in train an increase of executive interchange, and could form the basis of major expansion of private air transport.

It is a little ironic that the penetrations that have been made into the American businessman's market with British and European aircraft—the Dove, Heron, Viscount, F-27 Friendship, Morane-Saulnier Paris, and so forth—are by those types that, for the most part, have a rather specialized executive use in their countries of origin, since it is on the smaller touring-type aircraft that a wide expansion of executive transport is most likely to be based.

The British civil register lists some 457 aircraft under the category of business and private flying, but closer inspection shows that only about 170 of these are strictly business aircraft, and many of them are now woefully ancient; until the advent of the new Atlantic from Auster this year, virtually no really modern light business aircraft were offered by British firms. Business aviation in Great Britain is in danger of becoming stifled by the lack of suitable aircraft.

It is easy to see why business flying in the U.S. has achieved proportions that make it comparable with the densest public air-transport system in the world. The long distances to be covered, and the ready acceptance of one manufacturer's products anywhere from coast to coast, make frequent travel almost a prerequisite of successful enterprise to the American business executive. The aircraft market that has been encouraged as a result reflects that this acceptance is common to companies of every size; for while nearly all of the 100 major corporations in the United States own aircraft for executive use, this accounts for no more than a minute proportion of the total business hours flown. It has recently been calculated that this year there are 400,000 licensed private pilots in America, and the 60,000 private aircraft which were operating in 1955 flew 9½ million hours. Of these, 4.3 million were flown by business aircraft.

Supporting the pilots and operators of these machines is a network of distributors and maintenance companies who are helping to build up an industry that is expanding in parallel with the growth of air transport. Production by light aircraft manufacturers



Executives in demand: Piper Apache, Twin Bonanza and Aero Commander. The proportion of light twins to other categories of business and touring aircraft is steadily rising.

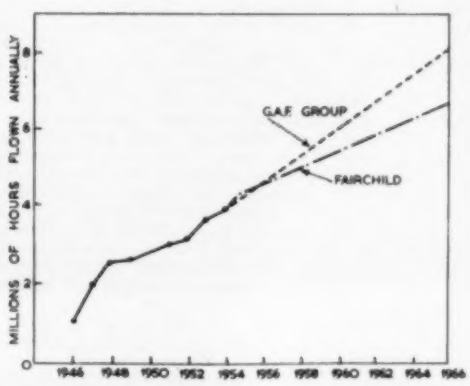
is higher than ever before, and still the demand remains unsatisfied. A flourishing business in conversions of DC-3s, Venturas, Invaders, Commandos and so on is helping to fill the gap, and the furnishing and refurbishing of executive interiors has become a profitable new business that can account for ten per cent of the selling price of an aircraft.

Considerable technical skill has been developed in executive interior furnishing to special order. Although in some instances this work is carried out by the manufacturers (Cessna brochures include sample trim and carpet materials for several matching or contrasting colour schemes), an opposing point of view—typified by Grumman with their Dart-powered Gulfstream—is to offer a "bare-hull" aircraft only (but equipped with air conditioning and airstairs) and leave it to appointed distributors to supply furnishing, radio, instruments and special equipment to the customer's choice.

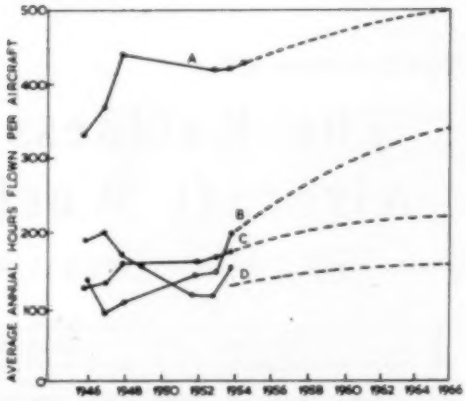
Comparisons between a firm's executive aircraft and the fleet of cars which it operates have been drawn before, since here is part of the key to the widespread adoption of aeroplanes, which are at first sight an uneconomically expensive form of executive transport. But with long distances to be covered, private air transport affords the businessman not only a welcome freedom of action, but the opportunity in one instance of continuing work or conference *en route*, or in another the pleasure and comparative relaxation of flying his own aircraft.

It can fairly be asked whether the growth of the business aircraft industry since the war is a mushroom expansion that is shortly to taper off. All the indications are that it is not, and the graph on this page shows two estimates of the probable growth, in business aircraft hours flown, for the early 1960s. The researches of the U.S. General Aviation Facilities Planning Group dealing with business aircraft examine development under categories of multi- and twin-engined aircraft and single-engined types with two seats or with three seats or more. The largest single group in 1956, when the survey was completed, was single-engined aircraft with two seats; but it seems likely that, by 1965, increased business needs will result in a preponderance of four-seat single-engined aircraft. Although twin-engined types (such as those shown in the heading picture to this article) represent only a small share of the total at the moment, according to the survey it is this group where the most rapid expansion is taking place, and where the average increase in utilization is greatest. Some estimates put the proportion of business hours flown by multi-engined aircraft as high as 30 per cent.

Business continues as usual in the cabin of a six-seat Hunting-Percival executive President.



Trend of business flying in the U.S.A. Forecasts of the growth of annual flying hours are those by Fairchild and the General Aviation Facilities Planning Group survey.



(Left) Piper Tri-Pacer; (below) Lockheed JetStar; (right) the utilization pattern of (A) multi engined, (B) twin-engined, (C) single-engined with three or more seats, (D) single-engined two-seat business aircraft, forecast to 1966.

THE BUSINESS-AIRCRAFT WORLD . . .

A study of the average utilization of each type of aircraft shows that the general trend is for hours flown per year to vary from about 200 for small single-engined aircraft to 450 for multi-engined aircraft in executive service. The latter figure may well represent the maximum *average* annual utilization likely to be achieved, since it would be unusual to employ more than one pilot to fly a firm's aircraft. There are over 3,500 business aircraft flown by professionals in the U.S.

It seems safe to predict that the field of turboprop-powered executives, at present limited to the Dart-powered Viscount, Accountant, F-27 and Gulfstream, will rapidly expand as engines such as the T53 from Lycoming, the Turmo or Artouste from Blackburn or small turboprops from such manufacturers as Armstrong Siddeley, Alvis or Continental (whose names have been coupled with such projects) reach production. That a choice of turbojets (notably the Bristol Orpheus, General Electric J85, Fairchild J83, Westinghouse J34 and Continental J69) is becoming available for the exclusive range of executive jets is thanks to parallel development for military needs, for with powerplant cost already representing 25 per cent of the total cost of a jet executive, it is unlikely that any manufacturer could afford the financial responsibility of engine development on an executive aircraft programme. Many of the smaller American manufacturers are in any case hard-pressed to raise the sums required to finance tooling and production facilities, and Taylorcraft (who recently celebrated the delivery of their 45,000th aircraft), Helio, Baumann, Colonial and others are turning to extensive subcontract work for assistance.

Prototypes of the handome new generation of executive jets—Lockheed's JetStar (produced and flown in 241 days), North American's Sabreliner, Fairchild's M-185F, and new projects from Cessna, Northrop, Temco and McDonnell—all with cruising speeds of Mach 0.76 and a range of 1,500 n.m.—are being financed by the U.S. industry. The rewards are U.S.A.F. production contracts involving 1,000 to 1,500 twin-jets and 200 to 300 four-jet utility aircraft on which civil production can be based.

No similar R.A.F. requirement has been formulated for advanced military communication and crew-readiness trainers (fifty M.S.760 Paris have been ordered for similar work in France), and British designs are unlikely to progress beyond the project stage without some prospect of military interest. Yet a demand exists for every classification of executive aircraft and profitable markets exist for manufacturers who can offer replacements for the obsolescing executive fleet and who are prepared to force the expansion pace of business flying. The U.S. scene indicates the scope: the prospects in Europe, if formidable, are stimulating and exciting.

Aeroplanes for Agricultural Work

EQUIPMENT FOR AN EXPANDING INDUSTRY

By a Special Correspondent

THOSE of us who derive a living from the operation of aircraft for agricultural purposes, such as spraying and dusting, believe that in time the aeroplane, like the tractor, will take its place as an accepted tool on farmlands and plantations the world over. But, unlike the tractor, the agricultural aeroplane did not have the advantage of starting life as a specialist vehicle. Operations from the early 1920s to the present day have been conducted with converted passenger aircraft fitted with special equipment (boom and nozzle gear, or hoppers) enabling them to work on the farm. Today there are thousands of such converted aircraft flying—mostly in the United States, but with an appreciable quantity in the Commonwealth (particularly New Zealand) and a few in the United Kingdom.

What are the characteristics of an ideal agricultural aeroplane? It must be cheap and safe; it must be rugged and capable of operating from small, rough landing strips, and it must be simple to maintain away from hangars and sophisticated facilities. The pilot should have a good reserve of power, 360-deg vision, and lightness of control so that he can make frequent take-offs, turns and landings without undue fatigue. Also necessary are a reasonable standard of cabin comfort and full protection against the dangerous chemicals that are sometimes carried.

Numerically, the Piper PA-18-A (Super Cub) is the foremost agricultural aircraft in service today, with an annual export production of over 450 units. This aeroplane is inexpensive, it can carry its own weight in chemicals, and is a fully proven type based on 25 years of Cub experience.

The backbone of American agricultural flying, however, is the much-reworked Stearman, now available with metal "high-lift" wings, a 450 h.p. engine and highly-developed specialist fittings. Stearmans have formed the basis of several new agricultural aircraft and conversions are offered by a number of companies in the U.S.

Aerial operations in New Zealand are perhaps the most publi-

cized in the Commonwealth, and here agricultural users have long urged British manufacturers to develop new aircraft tailor-made to meet their requirements, which predominantly concern top-dressing rather than spraying. This work is big business and accounts for many more hours per year than the local airlines and flying clubs put together. Two years ago, in nearly 85,000 hours' flying, 405,000 tons of superphosphate, lime and basic slag were dropped in addition to nearly 400,000 gallons of sprayed chemicals for weed and crops.

The operators' demands have been met with the Auster Agricola and the Percival E.P.9; both machines are now in operation in New Zealand and the manufacturers also expect to find a ready market in Australia and many other countries. Each design shows a specialist approach to the task in hand. Among the problems peculiar to agricultural work aircraft that have to be tackled are the combating of the corrosive effects on the aircraft structure of the chemicals carried, particularly when the dry materials become wet. Elevator and rudder control cables in both aircraft, for instance, are left exposed so that they can be easily inspected and cleaned, and the structures are of welded steel tube with fabric covering aft of the hopper. The Agricola's control cables are nylon-covered to prevent contamination.

Bearing in mind that in many parts of the world agricultural work is seasonal and sporadic, the E.P.9 has been designed to fulfil a dual rôle as an agricultural aircraft and a utility freight and passenger transport. The Agricola, on the other hand, is more closely tailored to agricultural needs. Another specialist aircraft is the American Fletcher, which also made its debut in New Zealand.

Here and in Africa the Tiger Moth is still widely used in an agricultural rôle. This aeroplane is particularly useful for operations where lighter application rates are required and the ability to carry heavy loads is less important. One British company, Crop Culture (Aerial), Ltd., has successfully operated Tigers in its fleet for two years and plans to use them again next season.

Another type of aircraft which has had a part to play in agriculture is the helicopter, but because of high operating costs and other factors, only a few are in use—mainly small helicopters, such as the Bell 47 and the Hiller 360s and 12Cs operated by Fison-Airwork, one of the largest industrial helicopter operators outside the U.S.

Helicopter protagonists claim that on every count but cost the rotary wing scores over the fixed wing for aerial spraying.

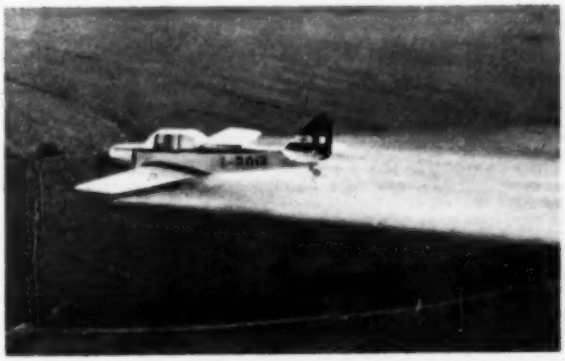
Several new types of aeroplanes have recently been built, among them the Kingsford Smith PL-7, the Transland Ag-2 (both developed "on the spot" from direct agricultural experience), the Czech Brigadyr and the Dutch HA-001; but little information is yet available to show how they are proving their worth.

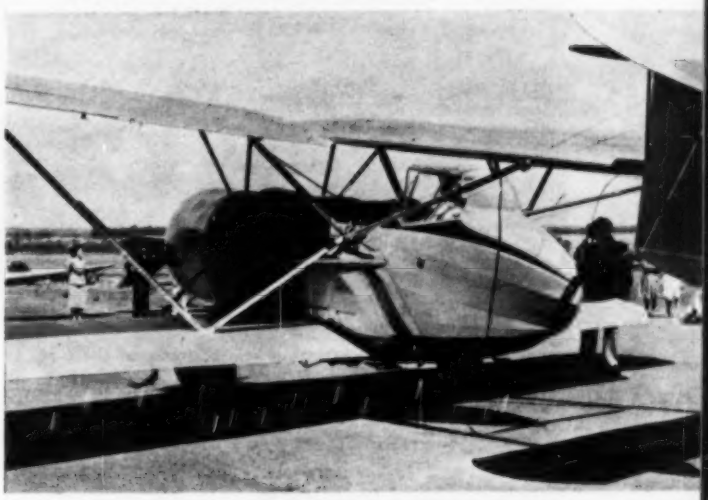
Looking ahead, it seems likely that the small, versatile aircraft will be in greatest demand, since capital for initial investment is still hard to come by in this growing and still new industry. At the same time there will undoubtedly be a place for larger machines of Bristol Freighter or Boeing KG-97 size, both of which have been used in the past for specialist operations. There is a growing need for more agricultural-flying training schools.

Finally, the equipment fitted to the aeroplane is as important as the aircraft itself in establishing a sound economy for agricultural work. Until recently, crop-spraying machines were fitted with rudimentary boom and nozzles which showed little improvement over the type towed behind a tractor by the farmer and, in the fertilizing and dusting rôles, aircraft hoppers have often lacked efficient spreaders. Consequently, chemicals have had to be diluted to allow for the shortcomings of application techniques.

One significant departure in spraying equipment is the Micronair rotary atomizer developed by Britten-Norman, Ltd. This produces uniform droplets to a finely controlled diameter, thus making it possible to cover larger acreages efficiently with a given quantity of liquid. Such equipment can be fitted to any agricultural aeroplane, and has already been exported to operators in most parts of the world.

Developments of this kind, together with improvements in chemical formulæ and the increased availability of aeroplanes designed specifically for agricultural work, promise well for the future of this vigorous and expanding branch of aviation.





Agriculturists of three nations. (Top) the Italian Meteor 55 Cargo Agricolo; (right) the unconventional Australian Kingsford Smith PL-7 tanker, and (below, left and right) contemporary British rivals, the Auster Agricola and Edgar Percival E.P.9.

BUSINESS AND TOURING AIRCRAFT

Current Types Reviewed

GREAT BRITAIN

Auster

Agricola The Agricola has been designed for spraying, dusting, top-dressing and other agricultural duties, including fence-dropping, supply-dropping, baiting and light freighting. Welded tubular-steel construction, with fabric covering, is used for the fuselage. The hopper-filling trunk is located behind the pilot in order that dust shall not be blown on to the windscreen during filling, even though the engine is running. Aft of this trunk is a two-seat passenger compartment for the carrying of ground crew. The rear fuselage is sealed to prevent the ingress of dust or spray fluids which, the makers observe, can easily lead to tail heaviness and dangerous flying characteristics. The control cables to the tail unit run outside the fuselage and are protected by a tough nylon covering.

The cockpit is of very sturdy construction, to afford maximum protection, particularly in the event of the aircraft turning over. Visibility is exceptionally good, and once the canopy is closed the cockpit is completely sealed, to prevent the admission of spilt dust. Wing construction is all metal, with fabric covering aft of the spar. Wings and ailerons are sealed to prevent contamination from chemicals and, as in the case of the fuselage, breathers are fitted to counter changes in atmospheric pressure. An hydraulically damped, wide-track (14ft 4in) undercarriage is fitted and is claimed by the makers to have the absorption capacity generally associated with deck-landing fighters.

The 240 h.p. Continental O-470-M engine has a special Auster-developed cooling system. No attention is needed from the pilot as the exhaust gases control the flow of cooling air through the large ducts. At all times, the makers claim, cooling remains proportional to the amount of power being delivered by the engine. The system for air is particularly effective during idling on the ground (e.g., whilst loading) when no ram-air is available for cooling. An electric starter is fitted and as a safety measure no battery is generally carried, though a battery and generator can be easily installed if required.

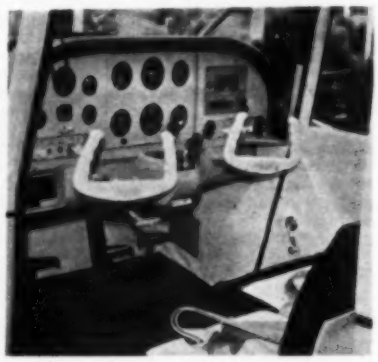
After flying the first Agricola last year a representative of *Flight* wrote: ". . . I spent most of the flight in close formation with the Auster Aiglet Trainer demonstrator while air-to-air photographs were being taken. This experience of formation flying after only a few minutes in the air alone really impressed me. The aircraft was stable but responsive, easy to handle and practically free from trim changes. I dropped five hundredweight of pelleted fertilizer across the airfield in a matter of seconds at 70 m.p.h. and could trace no trim or control changes during that time. After one and a half hours in the air I was completely confident of the machine and not at all fatigued."

Auster Agricola (Continental O-470-M).

Auster Atlantic (Continental E-185-10). Shown without wheel fairings.

Auster Alpine (de Havilland Gipsy Major 10).

Atlantic A brand-new Auster to be marketed in 1958, the Atlantic is a four-seater with nose-wheel undercarriage. It is to be produced in two versions, the first of which is styled Windsor de Luxe; the second will be the "thrift budget" Winchester, with less extensive equipment, the precise nature of which has not yet been announced.



Interior of Auster Atlantic Windsor de Luxe.

The Atlantic interior was available for examination, for the first time, at the recent S.B.A.C. Display, and *Flight* commented in these terms: "The cockpit, perhaps for the first time on a British aircraft, has been styled motor-car fashion to give it a definite sales appeal, and the result is very pleasing. On the facia is a central blind-flying panel flanked by a manifold pressure gauge, tachometer, cylinder-head thermometer, fuel contents and vacuum gauges, ammeter and flap and tail-trim indicators. The ignition is key operated with positions for left-hand, right-hand or both magnetos. In addition, there are controls for variable intensity instrument lighting, cabin air conditioning (including a blower fan), a cigar lighter, coat-hangers and so on. The throttle, mixture and pitch controls are mounted centrally for either left- or right-hand operation, and below the facia is the 'fly-off' parking lever for the differentially operated hydraulic brakes. Radio equipment is also built-in; the fuselage on the stand was equipped with a Broadcast range Model L.F.R.3 multi-channel low frequency receiver and a multi-channel V.H.F. receiver/transmitter. The structure follows the normal Auster practice of welded steel tubes, but the horizontally opposed Continental E-185-10, spatted tricycle undercarriage, wider cockpit and redesigned fuselage give the Atlantic an entirely different appearance from previous Auster aircraft. The mainwheel spats carry the landing lamps and entry step and the nosewheel is steerable."

Standard equipment of the Windsor de Luxe includes hydraulic brakes, parking brakes, steerable nosewheel, metal variable-pitch propeller, generator, starter, battery. Multi-layer soundproofing; stainless-steel exhaust mufflers; washable upholstery; pile carpets with foam underlay. High-gloss fire-resistant finish in choice of colour blends. Controlled heating and ventilation. Dual-control wheels. Individual ashtrays; map pockets; variable-intensity lighting for the instrument panel; parcel shelf; cabin lights and tailored travel cases.

Autocar The Autocar is basically a four-seater, adaptable for crop-dusting, spraying and numerous other duties, and is also available with a float undercarriage. The de Havilland Gipsy Major engine can be of the Series 1 (130 h.p.) or Series 10 (145 h.p.) rating. Dual controls are fitted. The interior is upholstered

Aviation Traders Accountant (two Rolls-Royce Dart RDa.6).

in hard-wearing material which tones with the colour of the exterior finish. There is ample leg-room between the front and rear seats, and a transparent roof and large windows afford a wide field of view. There is a compartment behind the rear seat for the stowage of personal luggage. Maintenance costs are very low, and four persons, or their equivalent, are carried for one hundred miles in one hour on about 7½ gallons of petrol.

Alpine This Auster type has been specially developed for operations from high-altitude fields in hot climates. Essentially it is a combination of the Aiglet's fuselage with the Autocar's wings; but other modifications, including more effective ailerons, have given it quite outstandingly good handling qualities and a degree of comfort superior to that of earlier Auster models. Though the Autocar has a capacious cabin and large payload capacity, in tropical climates and at high take-off altitudes these often cannot be fully utilized. The Alpine's rear-cabin accommodation is therefore scaled down while the large wing and powerful engine are retained, resulting in take-off and landing characteristics which are excellent for such operations. Yet the Alpine is more comfortable, for the front seat gives more leg-room and elbow-room than in the Autocar; and deep cushions, shaped to give pleasant support to the small of the back, have been added. The fact that the full 42.5in cabin width of the Aiglet is also retained means that two large people can be very comfortably seated. A rear bench-seat will accommodate a third person. There are also four adjustable ventilators, which mean much in the tropics, while sunblinds covering the whole of the roof Perspex are optional equipment to special order.

Auster Aircraft, Ltd., Rearsby Aerodrome, Nr. Leicester.

Aviation Traders

Accountant Announcing the maiden flight of the Accountant turboprop transport last July, Aviation Traders (Engineering), Ltd., declared potential markets to be "world wide—particularly to replace the DC-3 and Dakota-type aircraft and also for the business and executive operators on the American continent." They state that the Accountant has been produced at a cost far below that normally associated with modern aircraft, and they consider it to be capable of manufacture for sale at a price which should be competitive throughout the world.

Although it is recognized that different areas of the world present specific problems, Aviation Traders see a common pattern executive operation, and they state requirements as follows: (a) low initial cost; (b) ease and simplicity of maintenance, coupled with dependability; (c) high versatility in range; (d) ability to use airfields of restricted length and uneven surfaces; (e) adaptability of accommodation to enable carriage of a few people in luxury; a larger number of people in comfort; freight, or combination of both; (f) relatively high speed, with low circuit and approach speeds; (g) individuality of operation.

All these requirements they consider to have been met in the Accountant. They develop their philosophy in the following terms: "Speed has been referred to as 'relatively' high speed. This is important, as there is a common misconception that operators in this class will be requiring aircraft to fly at 500 m.p.h. with pure-jet engines in an endeavour to save time. The truth, however, is that the business operator cannot experiment with unproven equipment which at best will only give high speed with short range and a relatively small saving in time on a particularly restricted type of operation.

"The pure-jet high-speed transport has yet to be proved in major airline service, let alone feederline service, and certainly will not be experimented with by the majority of the business operators until it has been proven beyond all doubts and can be *applied* to fit the variety and flexibility of their operations.

"Despite these remarks business operators, with proven equipment, have established in the last decade (and undoubtedly will in the next decade) new patterns of aircraft operation. They are not bound by the same limitations as the airline operator, although in many cases disadvantages are apparent. Among these is, in many instances, the absence of large maintenance and engineering workshops—which highlights the necessity for the equipment they use having ease of maintenance and simplicity. . .

"The business operator has established for himself a very flexible type of operation, and the up-to-date equipment which is now needed must give the flexibility of use to meet the established pattern, but to an even greater degree and at a lower cost. In this regard the advent of the turboprop, in its now well-tried and proven form as the Rolls-Royce Dart RDa.6, is giving the best of all worlds to the business operator without risks being taken.

"The business operator is now at the *beginning* of the turboprop age which, with its over-the-weather-flying, smooth and quiet travel, represents a *great* advance on anything which these operators have had. On this basis, they can with confidence embark upon a decade of turboprop travel flying at 300 miles per hour in safety and comfort, and yet economically. At the same time, in the Accountant, they have the ability to fly the relatively long range of 2,500 miles non-stop.

"To meet the foregoing requirements the Accountant has been designed, and the cabin will allow 8/10 passengers to be carried for the maximum range of 2,500 miles, flying at 25,000ft at 300 m.p.h. At the same time the floor has been stressed for freight. Alternatively the aircraft can carry up to 28 passengers in comfort."

Civil Prentice Now being completed at Southend are ten of a substantial batch of ex-military Percival Prentices. The type has been cleared for a transport category C. of A. Aerobatic aircraft can be supplied if required. The manufacturers emphasize that the Civil Prentices meet the requirements of B.C.A.R.51, and a stickshaker stall-warning device is fitted. The modified aircraft are furnished in red Vynide with white piping as four/five-seaters, with adjustable front seats and a bench-type seat at the rear in which smoking may be permitted. The standard colour scheme is silver with a red flash, but trim and finish can be provided to choice. At a selling price of £1,825 the Prentice is equipped with four-channel V.H.F., engine and cockpit covers, landing and navigation lights, control locks, oil dilution, etc.

Aviation Traders (Engineering), Ltd., 21 Wigmore Street, London, W.1.

Bristol

Sycamore As an executive helicopter the Sycamore has a fully upholstered bench seat for three people fitted against the rear bulkhead of the cabin. A carpet is laid, soundproofing is installed, and the starboard rear opening is covered by a bulge-window panel and the port rear opening by a door. The makers claim that the Sycamore has the particular attraction, for passengers, of being remarkably free from vibration. They also make the point that the passenger seat, beside the pilot, gives an excellent field of view for occasions when it is necessary to make use of a passenger's local knowledge for guidance.

Bristol Aircraft, Ltd., Filton House, Bristol.

Bristol Sycamore (Alvis Leonides Mk 73).

Business and Touring Aircraft . . .

de Havilland

Dove Describing the "1958 model" of this world-famous twin-engined light transport/executive aircraft, the makers rightly refer to it as "a limousine on wings." As an executive aircraft the most favoured furnishing arrangement has four armchairs which can, if required, be made convertible into two full-length couches, and a fifth seat—with provision for a sixth—in the forward part of the cabin. At the rear is a comfortably equipped toilet compartment and accommodation for light luggage and clothing. Also aft is a large baggage compartment; and there is a second compartment in the nose of the machine. The cockpit seats two pilots with dual control and radio services.

de Havilland make these observations on the Dove as an executive aircraft: "A multi-engined aircraft is a necessity for most duties of this kind, and it is important that comprehensive navigational aids be installed to permit safe operation which is not seriously restricted by weather. Few aircraft available today from highly reputed builders combine these basic requirements in a vehicle suitable for a small party of four or six passengers, available at a moderate first cost and offering the advantages of low operating cost and maintenance expense. The Dove is indeed outstanding in this particular category for it is entirely modern in conception and detail specification and is backed by a world-wide distributing and servicing orga: ization.

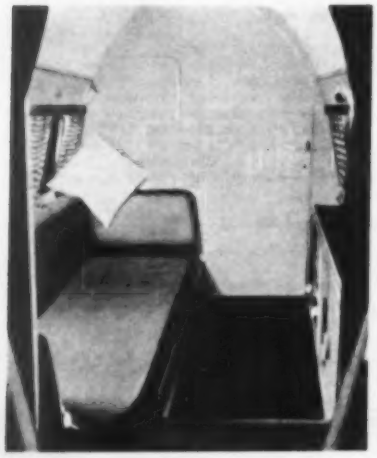
"Carrying four passengers and baggage and a crew of two the aircraft can make non-stop journeys of up to 880 miles in instrument flying conditions and with a fuel reserve sufficient for one hour's stand-off; alternatively, with six passengers and baggage and the same fuel reserve the practical stage would be about 650 miles. The cruising speed for this performance is 179 m.p.h. and the fuel consumption is no more than about 27.3 Imp. gal or 32.8 U.S. gal per hour. At slightly higher fuel consumption the aircraft cruises at 202 m.p.h.

"Such a performance proves useful to a great many individuals and business houses, and large numbers of Dove aircraft have been in personal service for several years in many parts of the world."

de Havilland Heron (four D.H. Gipsy Queen Series 30 Mk 2).

de Havilland Dove (two D.H. Gipsy Queen Series 70 Mk 2).

Below, couch in Heron Executive Special.



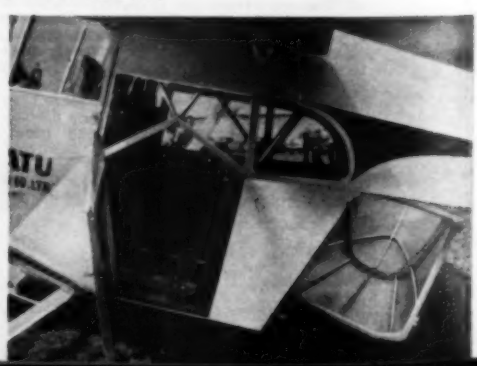
Heron The four-engined Heron is available in three executive layouts. The *Executive Special* and the *Executive de Luxe* versions have divided cabins, the former incorporating larger cupboard accommodation, a lounge and a small additional forward compartment. The *Standard Executive* version has a large individual cabin.

The makers differentiate between the three models in these terms: "The Heron *Executive Special* interior was devised in response to a demand for a private single cabin to which the owner may retire and in which he may have ample accommodation for personal or business papers, clothing, etc., as well as cupboards for refreshment. There is also a luxurious travelling compartment for four passengers. A small cabin is located forward for radio navigation or for use as a galley for preparing refreshments. The four-seat compartment is sufficiently large and comfortable for enjoyable travel, the adjustable armchairs being of full size and well spaced. The folding tables enable business discussions to be conducted, with convenient access to the bureau in the forward cabin; and meals can be served with ease. The owner's private forward cabin has a permanent couch on the port side which may serve as seating accommodation for up to four people in flight. Alternatively it provides a comfortable bed for one. It is wider at the head than at the foot, and the door leading forward to the small staff compartment is conveniently offset from centre. Beneath the long couch is further stowage accommodation.

"The Heron *Executive de Luxe* proves a satisfactory arrangement for the owner who visualizes holding business talks—while flying or on the ground—which may often need to be conducted in two groups. In each room there is spacious and comfortable seating, and the tables can be arranged as desired—full-width if needed. The chairs are adjustable instantly to the reclining position. Alternative cabinets for refreshments or for office files are fitted. The wardrobe behind the toilet compartment is a necessity and has a doorway into the main luggage hold. An additional hold is provided in the nose below the crew's compartment. The large windows ensure a well lighted interior.

"The Heron *Standard Executive* furnishing arrangement is a simple one in which the main cabin is undivided. This is preferred when the owner envisages that for the most part the vehicle will be employed for party travel by

Edgar Percival E.P.9s (Lycoming GO-480B). Below (right) hopper louvres and doors of E.P.9.



day, when the uninterrupted space will enhance the sociability and pleasure of the journey, and when a private sleeping facility will not as a rule be needed. It is a layout that makes the most of the available length, from the control cabin to the entrance door and toilet compartment, to secure the largest possible cabin. The impression of spaciousness is at its maximum. The eight large armchairs are afforded all the length required for reclining; ample room is still available for stowage cabinets. The large shelves behind the entrance door, on the port side of the toilet compartment, accommodate a good deal of light luggage that may be needed during the flight. The folding tables, which can be raised singly or to form two cabin-width spreads, are convenient for conference work."

The de Havilland Aircraft Co., Ltd., Hatfield, Herts.

Edgar Percival

E.P.9 Although designed primarily for agricultural work, the E.P.9 is suitable for many other types of operation. It can, for instance, function as a six-seat transport or as a light freighter. The high-set wings are metal-covered, as are flaps and ailerons. Steel tubing and fabric covering are used for the fuselage, and the undercarriage can handle vertical velocities of 9ft/sec. Flying controls are fully duplicated. Battery and generator, with electric starter, are standard equipment.

The construction of the aircraft was described in detail in *Flight* of December 30, 1955. In the issue of October 26, 1956, its handling characteristics were discussed; and an account of production methods was given in the issue of April 5 last.

In the first of these issues the design philosophy was presented, and the following are extracts:—

"For New Zealand [where Capt. Edgar Percival, the designer had made a first-hand survey], the main types of operations were: (1) aerial fertilizing; (2) anti-pest spraying; (3) supply-dropping to deer shooters (who are permanently employed in the mountain districts to destroy the large herds of wild deer); (4) the dropping of fence-posts and fencing material in the mountain country; and (5) transport of wool bales from remote mountain areas.

"In addition to meeting the important requirements of carrying as good a useful load as possible on a given size of engine and having a good performance from small landing strips, the cardinal points of agricultural-aircraft design must include the safety of the pilot. The topdressing work as performed in New Zealand can be considered more hazardous than other forms of regular flying, and there has been much argument in the past concerning the best position for the pilot. In many aircraft at present used for fertilizing, the pilot is located between and on a level with the engine and the load. As a result, he is the 'ham in the sandwich' in the event of a crash following engine failure during take-off or climb-away, especially in mountainous country. In the E.P.9 the pilot sits on a level which is above both the load and the engine.

"From the combination of the aircraft configuration and the pilot's position, a voluminous cargo space, or cabin space, results. This cargo space, coupled with the low loading platform of the cabin floor, Mr. Percival points out, makes the E.P.9 a true 'flying jeep.' It can be used for transporting sheep or other small animals, standard bales of wool and other goods. The cabin can be loaded through the large side or through the clamshell doors at the rear; standard 45-gal drums of petrol or oil can easily be rolled in and carried. . . .

"An important factor when moving from one site to another on topdressing operations is that, in the E.P.9, a ground crew of three persons can be carried in addition to the pilot and the hopper.

Capt. Percival further told *Flight*: "Because I was designing an aircraft that had a more universal application than for fertilizing and spraying alone, I decided a metal stressed-skin wing was called for to meet the durability case. After due consideration I decided that without doubt the high-wing layout was most suitable for agricultural and rough-country work; and because of the high-wing layout we were able to make use of light-alloy wing covering, since the fertilizer or spray chemicals were unlikely to come into contact with the wing. The fuselage has been made of steel tubing because this material appears to be the most suitable to combat the corrosive effect of some of the fertilizers and sprays used in agricultural work. With light-alloy skin covered structures the corrosive effect of the fertilizers used is most marked at the lapped joints and under the rivets."

Edgar Percival Aircraft, Ltd., Stapleford Tawney Aerodrome, Abridge, Essex.

Hunting Percival

Executive President The thinking behind the Executive President is contained in this extract from an "open letter" addressed by the makers to an imaginary businessman: "But are the national airlines in fact the quickest and most convenient means of personal travel for yourself and the key members of your staff about the continent of Europe, and perhaps further afield? They are speedy and comfortable, it is true, but do they fully meet your urgent need to travel *where* you will and *when* you will, and perhaps to continue with your work as you go? And is not much of your time wasted by the necessity to resort to surface transport to reach destinations often far beyond the airline terminals? You must often have wished that you could command an airliner of your own, routed to your own schedule, taking off and landing to your own timetable . . . with provision for your stenographer and her typewriter . . . maybe a voice recorder . . . an airliner in which your head executives can travel with you, so that you can confer with them in comfort and privacy as you fly to and from your appointments . . . a personal airliner which, at your bidding, will carry you from point to point over a far-spread choice of greater and smaller airfields, including many unrecognized by the major airlines. . . ."

In standard form the Executive President accommodates up to six passengers in the single cabin, which is notable for its generous headroom. Toilet and wardrobe facilities are provided, together with a refreshment buffet. All passenger seats are adjustable to a semi-reclining position, and the tables between the facing seats can be folded down out of the way if not required. In the nose and rear fuselage are holds for luggage, the latter being accessible in flight. A possible alternative arrangement of the main cabin accommodates four passengers, and a smaller fore cabin seats two others. Telephones can be fitted if required for communication with the cockpit.

The President's cabin volume is exceptional for an aircraft of its class, and the high wing gives an entirely unobstructed cabin roof and floor in addition, of course, to affording an excellent field of view for the occupants. The overall length of the interior is 20ft 0.75in and the width is 5ft 6in. The height is 6ft throughout most of its length, and the total available volume is 620 cu ft. The double opening doors provide an aperture measuring 5ft 2in by 4ft 2in.

Hunting Percival Aircraft, Ltd., Luton Airport, Beds.

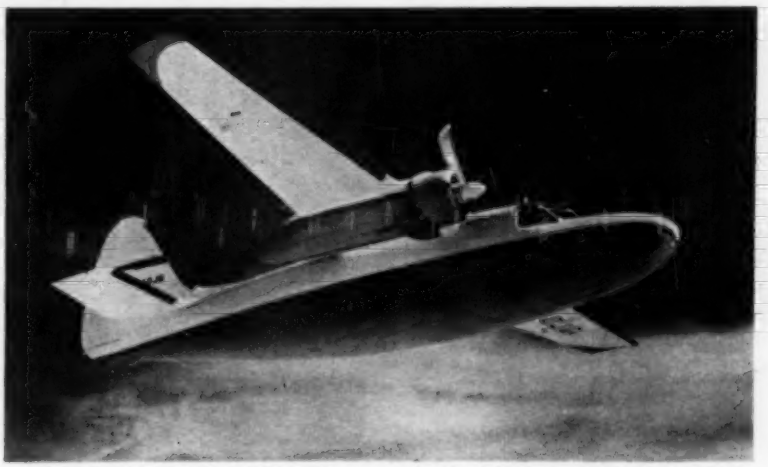
Jackaroo Aircraft

Jackaroo Mk 2 The Jackaroo is a conversion of the D.H. Tiger Moth and is claimed to be the cheapest four-seat aircraft in the world. Alternatively it is available as an agricultural machine and this version and the four-seater are fundamentally the same, the one being convertible into the other simply by adding three seats and a cabin top in the case of the agricultural model, and by removing two seats and adding a hopper in the case of the four-seater. Cost of the conversion kit in either case is £150.

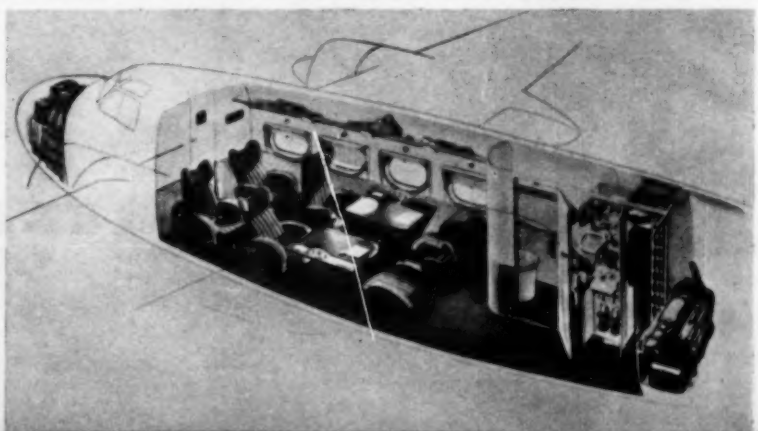
Three aircraft have been completed to date, and present planned production is for three a month, rising to four by March or April next. Thereafter, the makers say, production can be doubled. They give as "a conservative estimate" fifty orders for the agricultural version and about half that number for the crop-duster. A recent fitment is a Fairey metal propeller, which improves take-off performance, and disc brakes can be fitted as an optional extra at a cost of £80.

Practically the whole Tiger Moth structure is retained intact, and Tiger Moth spares, which are available almost everywhere, can therefore be used. The overhaul life of the engine is 1,500 hours, and overhauls cost £150.

Jackaroo Aircraft, Ltd., Thruxton Aerodrome, Thruxton, Andover, Hants.



Hunting Percival Executive President (two Alvis Leonides 503). Below: Typical interior.



Business and Touring Aircraft . . .

Vickers-Armstrongs

Viscount Executive The degree of comfort which can be achieved in the executive version of the Viscount turboprop transport is illustrated by a photograph on this page. Among the users of the Viscount in this rôle is the Brazilian President; and we can do no better than quote from an article in our American contemporary *Aviation Week* concerning the utilization of this aircraft:—

"In addition to being a high-speed transport for the President and other top government officials, the Viscount also is serving as a means of checking out Brazilian air force flight and ground crews in turbine transport operation. Providing these tangible assets, the turboprop transport also serves as an important public relations conversation piece and a crowd collector wherever the President goes.

"President Kubitschek has been averaging at least six flights monthly in his Viscount since he received it early this year; there are periods he will use it three and four times during a busy week. Because of Brazil's size and lack of adequate surface transportation, this country's politicians have to use aircraft instead of the traditional train in stumping the interior. Also, the President is promoting establishment of a new capital, located in the interior, called Brazilia, where he has had a special 2,400ft asphalt runway installed so that he can make frequent week-end trips publicizing the major re-location plan.

"Operations cost of the Viscount is reported to be slightly over that of a Convair 240, but less than for a Convair 340. The air force technicians, who fly and maintain the executive Viscount, say that it has an average cruising speed of 310 m.p.h. and it can make flights to virtually any spot in Brazil or South America with only one stop. Performance is such that it can carry the President and a party of 24 in and out of small fields such as Santa Maria, Rio Grande do Sul, which has a 4,264ft runway, where a Douglas DC-6 or Lockheed Constellation probably could not operate safely.

"Whenever the President wants to reach a spot in the interior where the field is too small for the Viscount, he flies to the nearest large enough airport and continues his journey in an air force Douglas C-47. He has found that by using the Viscount as a 'trunk-liner' and switching to smaller aircraft when needed, he gets in two or three times as much travelling as he previously did when using slower planes."

Future models of Viscount will be capable of cruising at 400 m.p.h., on the power of Dart 541 engines, thus further increasing the appeal to executive operators.

Vickers-Armstrongs (Aircraft), Ltd., Weybridge, Surrey.

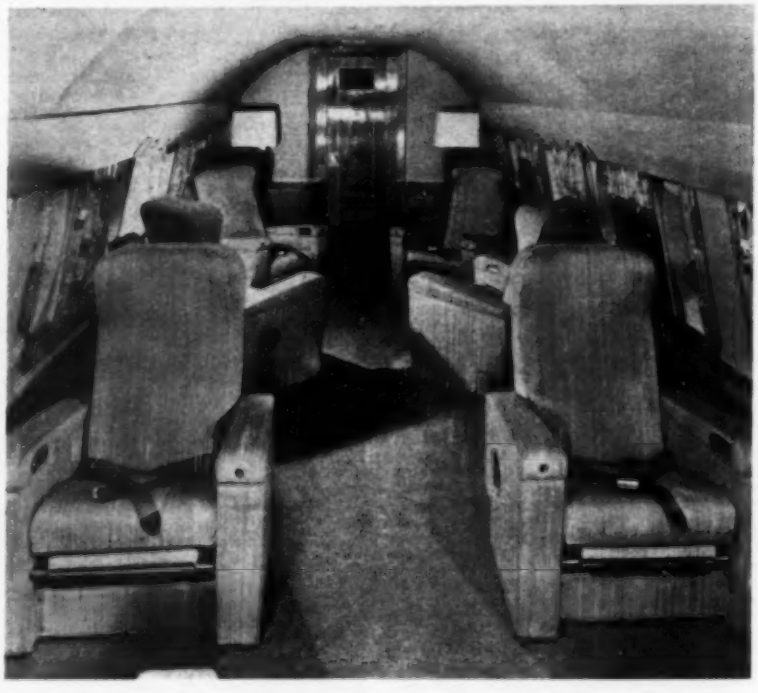
Westland

Widgeon As a passenger-carrying vehicle this helicopter seats four in comfort—three side by side in the rear of the soundproof cabin and one alongside the pilot. The windows and doors are large and soundproofing reduces noise. The seats can be quickly and simply removed when the aircraft is required for rôles other than passenger-carrying. A baggage compartment is located in the rear fuselage structure. The rotor blades can be folded backwards to reduce storage space.

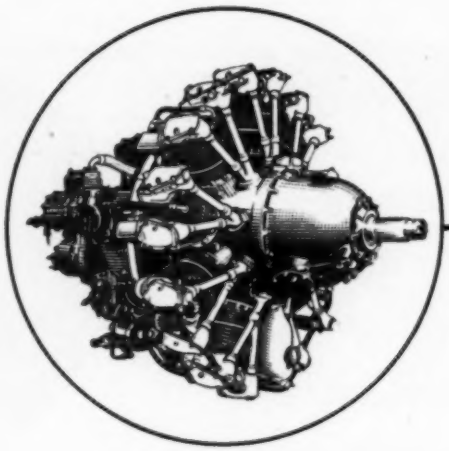
Crop-spraying equipment can be fitted to order.

Westland Aircraft, Ltd., Yeovil, Somerset.

Above, Jackaroo (D.H. Gipsy Major 1). Below, Westland Widgeon (Alvis Leonides 521/1).

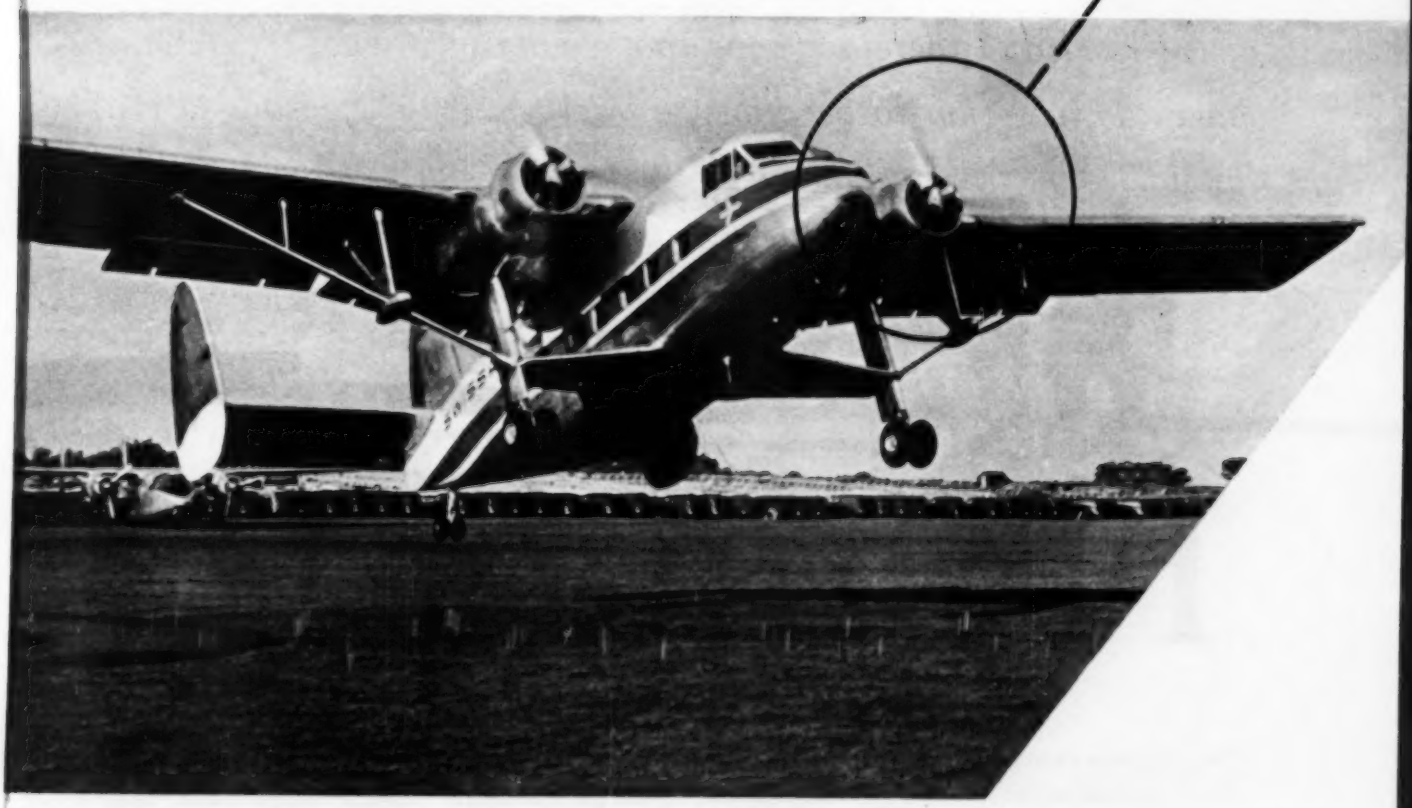


Below, Vickers-Armstrongs Viscount 764 (four Rolls-Royce Dart 510) for U.S. Steel. Above, interior of Standard Oil Viscount 765.



16 passengers take-off from a

ground run of only 100 yards



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'I should like to say a word about the future of the Royal Air Force . . . The introduction of new weapons will be a gradual process, extending over a good number of years, and even then there will still remain a very wide variety of roles for which manned aircraft will continue to be needed. I therefore hope that young men who have the ambition to be pilots, as well as those who are interested in new technical advances, will continue as before to look to the R.A.F. for a fine and useful career.'

MINISTER OF DEFENCE, APRIL 16TH 1957

Flying in the

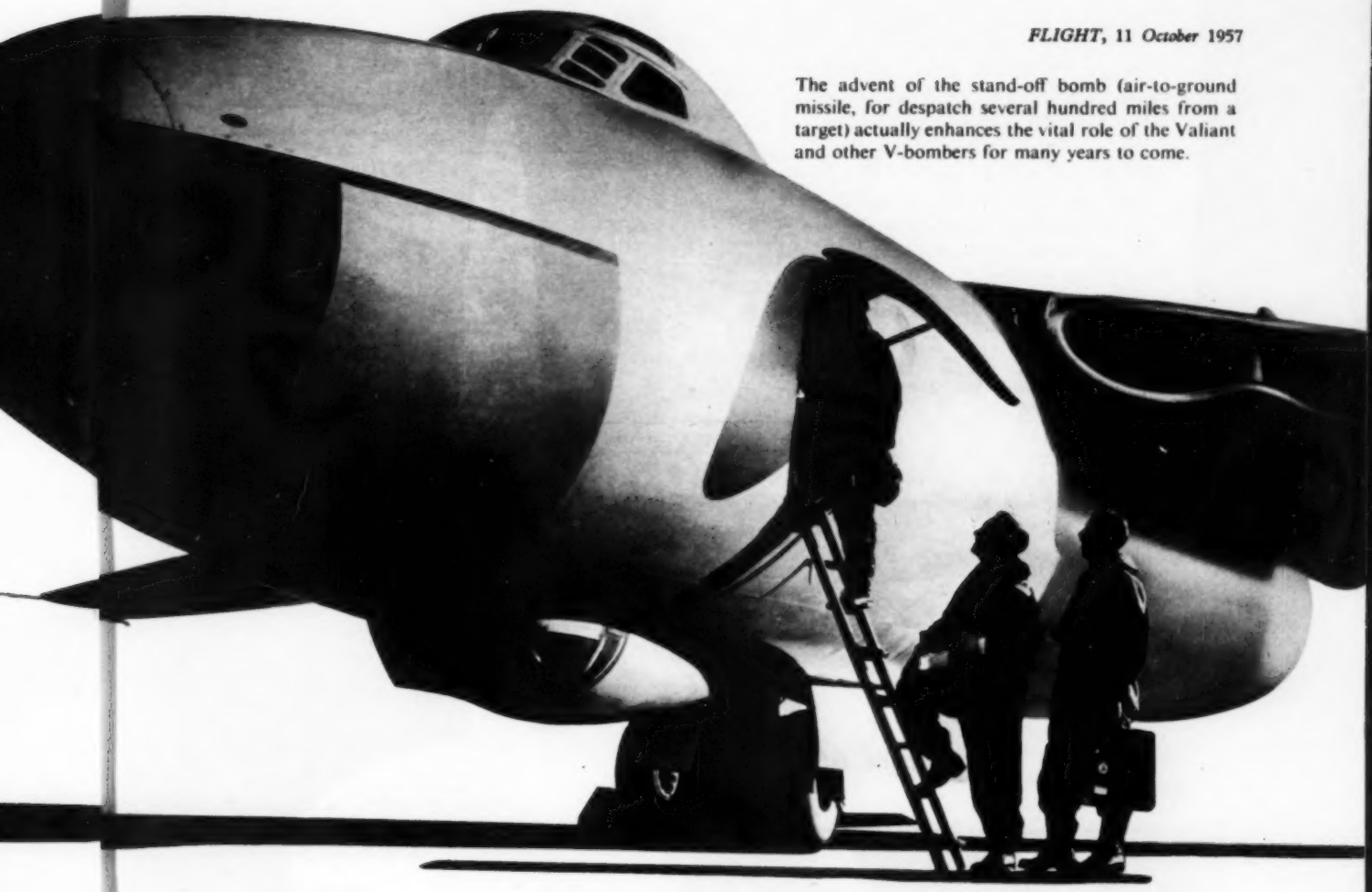
THE NEED FOR PILOTS, navigators and air electronics officers is as urgent as ever . . . and the career prospects no less promising. Weapons change, tactics change, but the role of the Royal Air Force today remains the same.

MORE OPPORTUNITIES—NOT LESS

To a young man ambitious to fly, and with the ability to lead others, the R.A.F. offers a fine and useful career. Men of high quality are required to fly the V-bombers, fighters and high-speed reconnaissance and transport aircraft. Even for those functions where unmanned missiles will in time give the answer, manned aircraft must continue in service for a number of years yet. Moreover, manned aircraft will *always* be needed for those functions to which the human brain in the air is indispensable. And, whatever new instruments of air power are evolved, the R.A.F. will always need men of initiative who have been trained to master the problems of the air in the air. For such men this is a time of opportunity. Not only can they fulfil their ambition to fly for as long as they serve. They will have the chance of a full and satisfying career. Aircrew do much more than fly. They are often seconded for other important work in Britain and abroad. Variety is more than ever the essence of a career in the R.A.F. Whatever a man becomes—pilot, navigator, air electronics officer—there is no limit to what he may achieve. Quality counts. There is, and always will be, room for good men.

A SURE FUTURE—GOOD PAY

You can join the R.A.F. through the Direct Commission Scheme, confident of a permanent career right up to pension age. Or you can choose a twelve-year engagement with the option of leaving after eight. If you leave after 12 years you take back to civilian life a tax-free gratuity of £4,000! Alternatively, there is a five-year Short Service Commission Scheme, and for University Graduates, a special four-year Short Service Commission. Whichever you choose, the pay is good. At the new rates, a



The advent of the stand-off bomb (air-to-ground missile, for despatch several hundred miles from a target) actually enhances the vital role of the Valiant and other V-bombers for many years to come.

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Flight Lieutenant of 25, can draw, with full allowances, about £1,500 a year.

HOW TO FLY WITH THE R.A.F.

You must be between 17½ and 25 and absolutely fit. You must have General Certificate of Education or Scottish Leaving Certificate or their equivalents. You must be able to lead others, and you must have aptitude as well as enthusiasm for flying. If you feel you have all these qualities, write at once for details of the schemes of entry and an informative booklet, to the Air Ministry (**FR5a**), Adastral House, London, W.C.1. Give date of birth and educational qualifications.

RESPONSIBILITY. To fly with the R.A.F. is to work with the most dependable men in the world, confident and well qualified for each of the many calls on their skill and initiative.

ADVENTURE. R.A.F. personnel were aboard the *M.V. Theron* as she returned with the advance party from the Commonwealth Trans-Antarctic Expedition, on the 23rd March this year.

The Royal Air Force *Flying . . . and a career*

Technical service to the aviation industry is part of the Shell tradition. At the Shell research laboratories in the United Kingdom, the Netherlands and the United States, teams of specialists — engineers, chemists, metallurgists — are constantly at work anticipating the fuel and lubrication requirements of the aviation industry.

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SHELL

AUSTRALIA

Kingsford Smith

PL-7 Tanker This unorthodox agricultural aircraft is powered with an Armstrong Siddeley Cheetah X engine, has twin tail booms, a nosewheel undercarriage and a 45 cu ft tank for top-dressing or crop-spraying chemicals. The forward section of the fuselage consists of a welded mild-steel tank forming a hopper and carrying all main loads. The forward face of the tank carries the engine-mounting frame and nosewheel boom; to the rear face is attached the rear-fuselage cone containing cockpit and fuel tank. The rear-fuselage section is fabricated from welded steel tube. Lower mainplanes are of welded steel tube and fabric-covered construction, with detachable light-alloy leading-edge sections. Full-span copper spray-booms are built into the trailing edges, with provision for a large number of standard spray nozzles. Composite construction is employed for the upper mainplanes, and the ailerons are fully slotted.

The fabric-covered steel-tube tail unit is carried on two four-inch-diameter tubular steel booms projecting rearwards from the rear face of the centre-section spar and braced to the tank unit. Twin fins and rudders, across the top of which the tailplane is carried, are attached at their mid-points to the booms. The large horn-balanced elevator has dual trim-tabs and the rudders are also horn-balanced. All control cable-runs from cockpit to tail are carried externally along the booms and boom supports.

CA.6 Ceres An agricultural conversion of the Wirraway, capable of carrying and spreading almost a ton of superphosphate. Spraying and seeding are also possible. Some twenty are being converted. The fuselage has been lengthened by 2ft and the span has been increased. The reduction gearing of the Wasp engine is being removed; the hydraulic system likewise; and the undercarriage will be locked in the down position and the flaps fixed at 10 deg deflection. The pilot's seat is raised 2ft.

Kingsford Smith Aviation Services Pty., Ltd., P.O. Box 11, Bankstown, N.S.W., Australia.

CANADA

de Havilland Canada

Agricultural Beaver The makers describe this as a "triple-duty" aircraft in that it combines the functions of spraying, fertilizing and supply dropping.

For top-dressing and seed-spreading the Beaver is equipped with a 35 cu ft hopper. Chemical fertilizer or seed is discharged under gravity through a chute. A roof hatch facilitates rapid loading and the average time between landing an empty aircraft and its take-off, fully loaded, is 65 seconds. At this rate, 20 round trips can be made in one hour. The density of the coverage is governed by the aperture of the chute door, which can be selected by the pilot according to requirements. Immediately aft of the door is the emergency release catch which can be tripped from a button on the pilot's control wheel. Fuel and electrical services in the vicinity of the chute are encased in stainless conduits. If necessary a push-button switch on the left horn of the steering wheel releases, on depression, the jettison doors of the hopper or of the spray fluid bag. The jettison gate will dump the entire load in a few seconds.

For liquid spraying work the attached booms emerge laterally from the sump and are braced to the airframe by struts. The outboard ends of the spray booms are fitted with ICD rotor units consisting of wind-driven fans rotating wire brushes which disperse the fluid in droplets. Valves at the rotor heads permit variations of the discharge rate from 1 to 50 gallons per minute and choice of suitable droplet size is afforded by a variety of brush sizes and types and fans of various pitches and capacities. The coverage per acre varies with altitude, speed, and flow setting; for example, at 25ft altitude and an airspeed of 90 m.p.h., the swath width would be 120ft and the coverage would be ½-gallon per acre for a flow of seven gallons per minute. The spray kit has been designed for rapid installation or removal.

The de Havilland Aircraft of Canada, Ltd., Postal Station L, Toronto, Canada.

Kingsford-Smith PL-7 Tanker (Armstrong Siddeley Cheetah X).

de Havilland Agricultural Beaver (Pratt and Whitney R-985).

GERMANY

Dornier

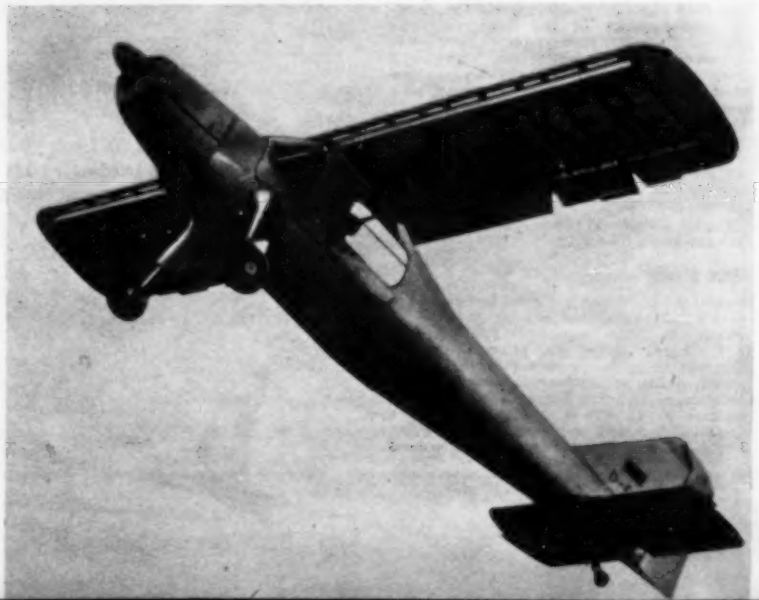
Do 27 This very remarkable four-seater was the subject of an air test in our issue of June 14 last. It was then remarked that the machine was particularly designed not so much for slow flying as for safe manœuvring at very low speeds.

The whole airframe is built up round a strong floor structure, which carries the single main frame holding the torsion-box wing and the Lycoming 270 h.p. engine. A single post in the middle of sharply swept windscreen serves as a crash pylon. Both screen panels are themselves upward-opening doors to which access is gained by climbing over the wheels and on to a footstep on the undercarriage leg.

After his air test *Flight's* representative summarized his impressions as follows: "The outstanding feature of the Do 27 is its slow-flying behaviour. It is not only fully manœuvrable at 40 kt, keeping an ample reserve of power for an immediate climb, but it is actually pleasant to handle under these conditions. It really feels absolutely right to be stooging along at 40 kt, casually watching one's shadow amble across the fields underneath. The stick can be pulled straight back to the stop and, provided the tailplane is not seriously out of trim, nothing untoward will happen. The turning circle is remarkably small, and is very greatly decreased by application of flap. The Do 27's flying characteristics are, in fact, as distinctive as its appearance."

Dornier-Werke G.m.b.H., Friedrichshafen a.B., W. Germany.

Dornier Do 27 (Lycoming GO-480).



Top, Boisavia Mercurey (Lycoming O-320). Paul Aubert Super Cigale (Lycoming O-320).

Business and Touring Aircraft . . .

FRANCE

Paul Aubert

P.A.204 Ly Super Cigale This eyeable high-wing monoplane is powered with a Lycoming engine of 150 or 180 h.p. A four-seater, it has a soundproofed cabin and is of all wood construction. A constant-speed Hartzell propeller is standard.

Several Super Cigales have been completed and a number have been supplied to the Air France Aero Club.

Avions Paul Aubert, 6 Square Debussy, Paris XII, France.

Boisavia

Mercurey The latest version of the Mercurey four-seat high-wing monoplane is shown in a photograph on this page. It has a Lycoming 150 h.p. engine, whereas most of the earlier Mercureys had SNECMA Regniers. The wooden wing has a stressed plywood skin and the fuselage is of welded steel tube construction with fabric covering. Dual controls are fitted for the occupants of the front seats and there is a baggage compartment aft of the soundproofed cabin.

B.260 Anjou Of five Anjou twin-engined low-wing monoplanes constructed to date, one is being prepared to take Lycoming engines in place of the SNECMA 4 LO2s installed in the other examples. The first Anjou flew in June 1956 with the French engines. The essential characteristics of the design will be gathered from the photograph. The wing is of two-spar metal construction, with metal covering except for two inter-spar areas, where fabric is used. The fuselage is of steel tube construction and is partly metal and partly fabric covered. Seating is provided for four or five persons.

In conformity with the most modern American practice, the engine can be fitted with wing-tip fuel tanks, which increase the range to over 1,200 miles.

Société Boisavia, 11 rue Pierre-Brossolette, Ivry-sur-Seine, France.

Max Holste

Broussard In civilian guise the Broussard can serve as an agricultural aircraft or executive vehicle. In many respects it resembles the D.H. Canada Beaver, the principal external difference being the Broussard's twin fins and rudders and its spring-steel undercarriage legs, made under American licence. The Pratt and Whitney R-985 450 h.p. engine, driving a Hamilton Standard constant-speed propeller, provides an ample reserve of power for tropical operation. Equipped for passenger-carrying, the Broussard seats six in three pairs. Dual controls are provided for the front pair.

Super Broussard MH-250 Ten of these interesting twin-engined aircraft are being built. Two of them will be retained for development and demonstration work and the others are already committed by civil and military orders. The first example should fly next June.

A full-scale mock-up of the cabin was shown at the Paris Salon this year, and on that occasion *Flight* reported: "A major feature of the MH-250 is that it is intended from the outset to take either Pratt and Whitney R-1340s of 600 h.p. or turboprops of equivalent power (Turboméca Bastans). All piping and control runs are adaptable to either powerplant, and the change-over can be made with the minimum of modifications. Despite its bush-flying operational rôle, the MH-250 is provided with autopilot (Sperry AL-30) and complete radio and blind-flying equipment. The retractable undercarriage is another unusual feature in such an aircraft."

Avions Max Holste, 11 rue Gosset, Reims, France.

Morane-Saulnier

M.S.760 Paris The twin-jet Paris has set an entirely new fashion in executive aircraft, and fully deserves description in some detail. This is no better achieved than by quoting the report of C. M. Lambert after an air test on behalf of this journal, printed in our issue of June 29, 1956. He wrote: "Every now and then one finds a real peach of an aircraft—one which performs and behaves in relation to its intended rôle exactly as it ought to. My most recent delight was the Morane-Saulnier M.S.760 Paris, which I flew in France soon after it had returned from its North American sales tour for Beechcraft. The aircraft still carried its splendid white, blue and red trim, and on its nose was a map of the U.S.A., showing the route it had followed on its tour.

"From outside the Paris looks well, but inside it looks better still. The predominant cabin colour is pale grey, with occasional red piping. Panels and consoles are all grey and instruments are black with white lettering. Everything stands out clearly and is easily recognized by distinctive shaping and marking.

"The four seats naturally take up almost all the available space in the cabin and getting in without dirtying them with the feet would be tricky if it were not for the fact that the central arm-rest in the front bench can be swung up and forward to expose a long, flat, metal-faced footstep. A short ladder can be attached to either flank of the fuselage to take the passenger up two or three feet to cabin sill level. Once installed, the view is excellent in all directions, particularly over the nose . . .

"The sliding plastic canopy is large and can make the cabin very hot in bright sunshine, so adjustable purple plastic visors are fitted in the windscreen bridge for the front seats, together with four fully adjustable cloth concertina blinds in the roof. So shade is not hard to come by; and the addition of a full-scale air-conditioning system makes life very pleasant. The Paris is, of course, also fully pressurized. The canopy is opened or closed by an electric motor and the pressurization seal is separately inflated by moving a manual control on the right windscreen sill. The conditioned air, derived from compressor bleeds on the two Turboméca Marboré II engines, is passed through expansion turbine and heat-exchanger,

Above, Boisavia Anjou (two SNECMA 4 LO2). Below: Max Holste Broussard (P. and W. R-985).

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Operating simplicity and reliability.

- **Self contained size 40" × 30" × 54" on casters for ease of movement.**
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This machine will be demonstrated publicly for the first time on

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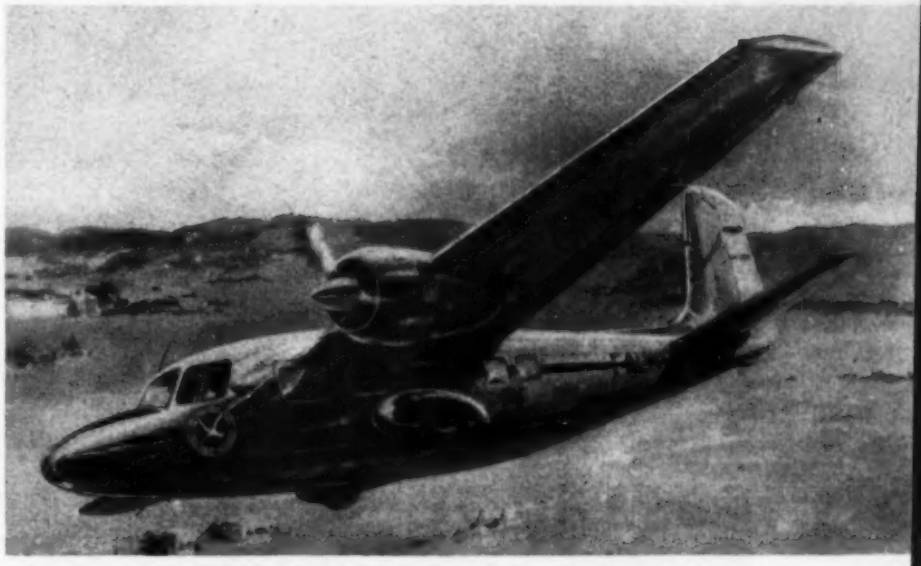
and cabin temperature can be fully adjusted.

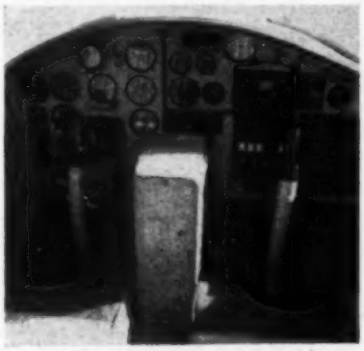
"Jean Cliquet, the Paris test pilot who took me up, started the engines with the aid of an external battery and activated all the necessary circuits for instrumentation and radio. He taxied out using the steerable nosewheel, setting a spanking pace down the long, straight Villacoublay taxi-way. There was, of course, no need to run-up the engines and, after turning on to the runway, setting trims and checking switches, we were smartly away. The take-off took 20 sec, the Paris unsticking at 92 kt with four people up; and by the time we reached the end of the 2,000 yd runway we were making 150 kt.

"Cliquet held the aircraft level for a while until we reached 215 kt, when he settled into a 1,640ft/min climb at climbing power. On the way up we engaged hood-seal inflation and selected air-conditioning with a pleasant flow of cool air. Though the pressurized atmosphere produced in the cabin is never quite the same as plain untreated air, it is pleasant to be able to regulate the temperature to be just right . . .

"For a demonstration stall the power levers were pulled back and the speed fell off very slowly. After a long wait we reached 92 kt and, with the nose held up at about 15 deg, rough airframe buffeting developed into a straight stall. With the stick held well back neither nose nor wing dropped and the Paris continued to lose height in that attitude until Cliquet let go of the stick. The aircraft then dropped its nose and recovered straight ahead all by itself."



Max Holste Super Broussard (two Pratt and Whitney R-1340).



Below, Morane-Saulnier Paris (two Turboméca Marboré II). Above, the interior of the same.

Having had the Paris demonstrated for him by the Morane-Saulnier test pilot, Mr. Lambert tried it for himself and wrote as follows: "I soon began to enjoy that balance of steadiness and responsiveness which is the hallmark of a well-harmonized control system. I turned and dived and zoomed happily for several minutes and then asked somewhat hesitantly whether, with four people up, it would be in order to try a roll (as a two-seat trainer the Paris is, of course, fully aerobatic and spinworthy, but I wasn't sure about such things with four occupants). Cliquet just gestured briefly and, enjoining everyone to tighten his harness, I rolled it as cautiously as if I was turning over a crate of eggs. I need not have worried; the aircraft behaved perfectly, showing no unnatural tendency to fall out of the roll or do anything strange. I rolled again several times, taking care, for the passengers' sake, to apply the minimum of negative g, and felt rather pleased at performing at least a minor aerobatic manœuvre in a jet aircraft carrying four people—though not forgetting that "Tex" Johnston had rolled a slightly larger passenger aircraft, the Boeing 707. . . .

"I still look back on my trip in the Paris as one of the most pleasant I have had in any kind of executive aircraft. From the pilot's point of view the Paris certainly deserves every success it may achieve."

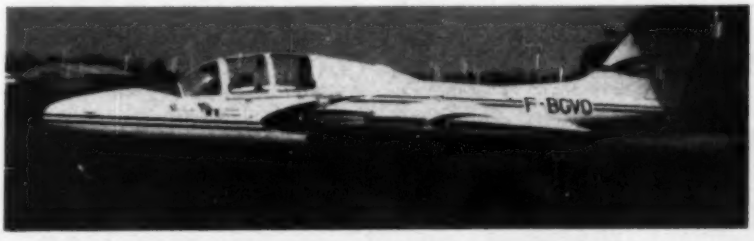
Société Morane-Saulnier, 3 et 5, rue Volta, Puteaux.

Sud-Aviation

Gouverneur The Gouverneur is a splendid example of a modern executive helicopter, being of up-to-date design and having gas turbine power (a Turboméca Artouste II of 360 h.p. max.). The cabin seats the pilot and four passengers in comfort and quiet, and excellent visibility is afforded by the large transparent panels. Features include soundproofed upholstery; carpeted floor; passengers' seats with head-rest and folding central arm-rest; baggage compartment under the passengers' seats for two suitcases; and anti-glare curtains which slide out of sight in the ceiling. V.H.F. radio, dual control, blind-flying equipment, night-flying equipment and rotor brake are optional items of equipment.

Djinn Depicted below is the little Djinn helicopter—powered with Turboméca Palouste compressor, supplying air to tip jets—operating in the agricultural rôle. Additionally, the makers claim, it is very suitable for forestry and conservation work—for controlling flood zones and inspecting forested areas as well as for animal husbandry and wild-life control.

Sud-Aviation, 37 Boulevard de Montmorency, Paris, XVI.



Below, Sud-Aviation Gouverneur (Turboméca Artouste II).

Sud-Aviation Djinn (Turboméca Palouste).

Aero Commander 680 Super (two Lycoming GSO-480-A1A6). (Below, left) Interior of a typically furnished Commander 560.

Business and Touring Aircraft . . .

UNITED STATES

Aero

Commander First certificated in January 1952, the Aero Commander has become firmly established as a business aircraft in the U.S.A. and many other countries. The two current production versions are the Model 560E and Model 680 Super.

Since June of this year the 560E has succeeded the 560A as the standard unsupercharged Commander. It differs from all previous versions in having an additional 29 inches on each wing-tip, and the resulting increase in lifting ability confers upon it a greater range than that of any other light twin in the U.S.A. Moreover, it is cheaper than the HC 560A, i.e., the 560A fitted with high-compression engines similar to those of the 560E.

Like all Commanders the 560E has a cabin 127.5in long, 52in wide and 53in high. The available space totals 177 cu ft, into which are normally fitted two adjustable and reclining seats for two pilots and a bench for three at the rear. In addition, a baggage compartment is provided with a volumetric capacity of 32 cu ft and a weight limit of 350 lb. Special interiors can be provided for up to seven persons, or for smaller numbers together with folding tables or wall couches, or, alternatively, the whole interior can be stripped for freight carrying. In the latter connection it is relevant to note that the door (43in by 26in) is only 20in from the ground.

The high-compression Lycoming flat-six engines, each rated at 295 h.p., drive Hartzell three-blade constant-speed feathering and reversing propellers. Fuel is housed in flexible cells in the wing and top of the fuselage, with a total usable capacity of 185.7 Imp. gal—56 gal more than earlier Commanders. This substantial capacity makes it possible for the 560E to fly 1,625 miles with a 30-minute reserve, cruising at 10,000ft at 55 per cent power (182 m.p.h.). Other mechanical features include semi-slotted flaps with hydraulic actuation, "augmenter tube" exhaust stacks and a hydraulically retracted nosewheel undercarriage with three-piston single-disc brakes.

The Model 680 Super differs from all previous Commanders in having supercharged Lycoming GSO-480-A1A6 engines, each rated at 340 h.p. While retaining the original 44ft-span wing, the Super has the same fuel and oil systems as the 560E, and so has comparable range (about 1,480 miles at 10,000ft at 55 per cent power, in this case giving an airspeed of about 205 m.p.h.).

All Commanders are marketed with any of six groups of radio and navigation equipment, costing from $10,250 to $42,500. Most costly equipment includes the Collins 360-channel V.H.F., plus dual navigation equipment and a Collins Integrated Flight System. Other items which can readily be fitted include the Lear L-2 autopilot, with altitude control and approach coupler, together with Narco D.M.E. and Goodrich de-icing equipment on the wings, tail and propeller blades. Another optional extra is a hassock chair which can be folded out to form a bed and contains an ice-box or a chemical toilet. A number of Commanders have recently been fitted with weather radar, usually the R.C.A. AVQ-50.

Total production to date is well in excess of 600, and the rate of delivery is greater than one aircraft per working day. We published a report of an air test of an earlier Commander (a series 560A) on December 24, 1954.

Aero Design and Engineering Co., Bethany, Oklahoma.

Beech

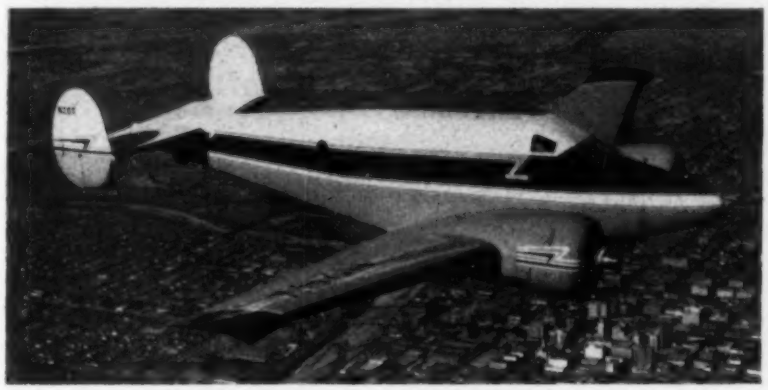
Bonanza The current production version of this world-wide favourite is the Beechcraft Model H 35, powered by an up-rated Continental flat-six engine of 240 h.p. Since pro-

Beech Model 95 Travel Air (two Lycoming O-360-A1A).

(Below) Beech Model 35 Bonanza (Continental O-470-G).

Beech Model E-50 Twin Bonanza (two Lycoming GSO-480-A1A6).

E-50 Twin Bonanza interior.



Beech Super 18 (two Pratt and Whitney R-985-14N).

duction began in 1946 over 5,000 Bonanzas have been delivered and, although the airframe has not been substantially changed, detailed improvements have been introduced annually. All Bonanzas are four-seat aircraft provided with equipment similar to that quoted for the Travel Air Model 95. A novel feature is the use of a "butterfly" tail, although the flying controls in the cockpit are quite conventional. Two wing tanks house a total of 32.5 Imp. gal (47.5 Imp. gal usable with auxiliary tanks) and cruising consumption is about 25 m.p.g.

Travel Air The Beech Model 95 Travel Air first flew in August last year. It is essentially a scaled-down Twin Bonanza, seating four persons and having a cruising speed of 200 m.p.h. (at 75 per cent power at 7,500ft). Powerplants are Lycoming flat-fours, driving two-blade constant-speed propellers and a full range of accessories.

Basically the Travel Air has the Bonanza's cabin, the Mentor's wing, tail and undercarriage and the wing-tip plan of the Super 18. Behaviour on the flight test programme has been quite outstanding and the noise level is actually some three decibels lower than that in the Bonanza, previously one of the quietest of any small aircraft. Standard cabin equipment includes ultra-violet-proof transparent areas and tinted side windows, full sound-proofing, a loudspeaker, map and glove compartments, adjustable sunshades, four ash-trays, a cigarette lighter, a D.V. panel, a coat hanger, radio, map pockets, arm rests, and adjustable and reclining seats with shoulder harnesses. Optional equipment includes additional tankage, a Grimes rotating beacon and air conditioning (as distinct from mere heating).

Typical of the flight performance of the aircraft are two standard demonstrations: starting at 200 m.p.h. at low altitude the Travel Air can have one engine feathered and then be rolled against the dead engine; or, from the same initial conditions, both propellers can be feathered and the aircraft can then be pulled up to make a normal circuit approach and dead-stick landing on the spot where the engines were originally feathered.

Twin Bonanza Production is at present concentrated upon the Model D 50, powered by two Lycoming flat-six engines, and the E 50 (illustrated) fitted with supercharged engines and cleared to operate at a substantially increased weight. All Twin Bonanzas are six-seaters, the interior cabin width of 54in being comparable to that of the largest American cars. Alternative seating schemes provide for a sliding co-pilot's seat and two reclining chairs at the rear or a three-place front seat and a reclining chair and axially disposed couch behind.

Provision is made for 500 lb of baggage, and the aircraft can be equipped with a very extensive range of standard or optional devices including a combustion heater, an air-conditioner, special sound-proofing, full protection against icing and a wide range of combinations of communications and navigational radio equipment. Inboard and outboard wing tanks house a total of 112 Imp. gal (D 50) or 150 Imp. gal (E 50) with optional auxiliary wing tanks adding a further 38 or 42 Imp. gal respectively. Both types of Twin Bonanza have ultimate ranges in excess of 1,600 miles and a corresponding endurance of some ten hours. About 400 have been delivered, and the type is also in service with the U.S. Army as the L-23.

Super 18 Widely known as the Twin Beech, the Beechcraft Model 18 (usually the D 18S) is in use in all parts of the world. The current version, which is otherwise known as the E 18S, embodies numerous improvements, which include several airframe changes to reduce drag and improve performance, as well as more effective soundproofing, a revised cockpit, integral air-stairs and extra operational equipment. The Super 18 is normally fitted for a crew of two and from five to seven passengers. Total usable fuel capacity is 238 Imp. gal, and the cruising consumption approximately 27 gal/hr.

Beech Aircraft Corporation, Wichita, Kansas.

Bell

47 Well over 500 Bell 47 helicopters are now in commercial operation and a very much greater number are used by the world's military services. The most important current

Bell Model 47J Ranger (Lycoming VO-435); right, interior of Presidential Model 47J.

Business and Touring Aircraft . . .

model is the 47J Ranger, which is the first four-seat utility helicopter to go on to the American market. The pilot is seated centrally in front of a bench seat for three, and the latter can be removed to permit the installation of stretchers. Alternatively, the passenger seat can be folded back to leave a clear space for up to 650 lb of freight and an electrically powered hoist can be fitted on the port side for loading or rescue work.

Earlier Bell helicopters were Franklin-powered, but the 47J has a Lycoming flat-six engine de-rated from 250 to 220 h.p. Other features introduced with this model are an all-metal rotor of 37ft 2in diameter, and numerous executive or special-purpose accessories (including a "plush" interior, new pontoon floats and a long-range fuel system). The 47J went into production at the end of 1956 and the first batch of 15 was delivered the following month. The rate of production has increased steadily throughout the current year.

The basic model 47G, which is licence-produced in Italy by the Agusta company and by the Kawasaki company in Japan, has a bench seat for three and is powered by a 200 h.p. vertically-mounted Franklin. With a useful load of 915 lb, the basic G model sells for $41,500 and is therefore the cheapest mass-produced helicopter on the market. A development of this aircraft which went into production last year is the 47G-2, powered with the Lycoming VO-435 (the same engine as the Ranger) de-rated to 200 h.p. Although the useful load has been reduced slightly to 886 lb the flight performance is very considerably improved and the ceiling, at 15,700ft, is almost double that of the original G. The price is $44,500. For $5,000 more one can purchase the 47H-1, named Bellairus, which is a *de luxe* version—somewhat similar in appearance to the larger 47J—powered by the smaller Franklin engine.

Overall Bell production of commercial helicopters is greater than that of any other manufacturer in the world. A total of 84 commercial Bells were delivered in 1955, over 120 in 1956 (including 75 47G-2s) and the current year's production will be still greater.

Bell Helicopter Corporation, Ft. Worth, Texas.

Camair

480 Originally developed to meet the parent company's own business needs, the Camair 480 has proved so successful that a considerable number have been sold to outside buyers. Similar in configuration to the Twin Navion (and based largely on that aircraft) the 480 is a four-seater powered by two Continental flat-six engines. A distinguishing feature is the use of circular-section wing-tip tanks which add a total of 58 Imp. gal to the internal capacity of 32.5 gal.

Camair Division of Cameron Iron Works, Inc., Galveston, Texas.

Cessna

620 Larger than any other Cessna product, the four-engined Model 620 is truly an airliner in miniature, embodying virtually all the refinements found in the largest long-range transports. Since 1954 a self-contained team of some hundred engineers has been engaged in its development; the prototype flew fourteen months ago and production deliveries are scheduled to begin in the first quarter of 1958.

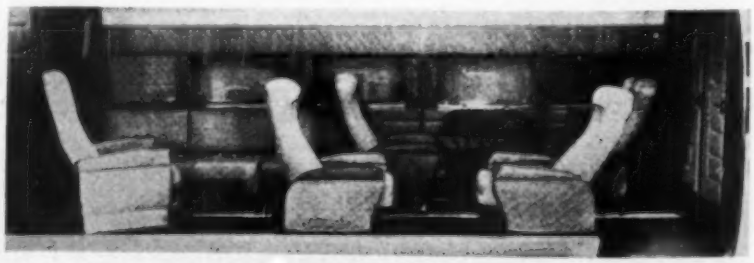
Cessna 180 floatplane (Continental O-470K)

Seat tracks stressed to 10 g run the length of the cabin, which is 13ft 3in long and has a constant section 68in wide and 72in high. Behind the rear baggage compartment is an AiResearch gas-turbine set for cabin-conditioning and pressurization (it also provides electrical power on the ground); at 18,000ft the cabin interior can be maintained at 8,000ft equivalent. The rear baggage bay has a capacity of 500 lb, and a toilet is fitted on the left-hand side of the fuselage adjacent to the main entrance aft of the wing. The latter door is equipped with air-stairs and has multiple latches so designed that the door cannot be opened when the cabin is pressurized. The standard interior has five sleeper-type seats and a folding table; another typical layout specifies eleven passengers, and in all versions provision is made for a crew of two in the airliner-type flight deck.

The four Continental flat-six engines are installed in special low-drag cowlings with dual exhaust-augmenters. Nacelle skins and firewalls are of titanium and the propellers are three-blade feathering units of 93in diameter. A total of 445 Imp. gal of fuel is contained in a four-tank system between the wing spars, extending from the inner engines to the streamlined tanks on the wing tips.

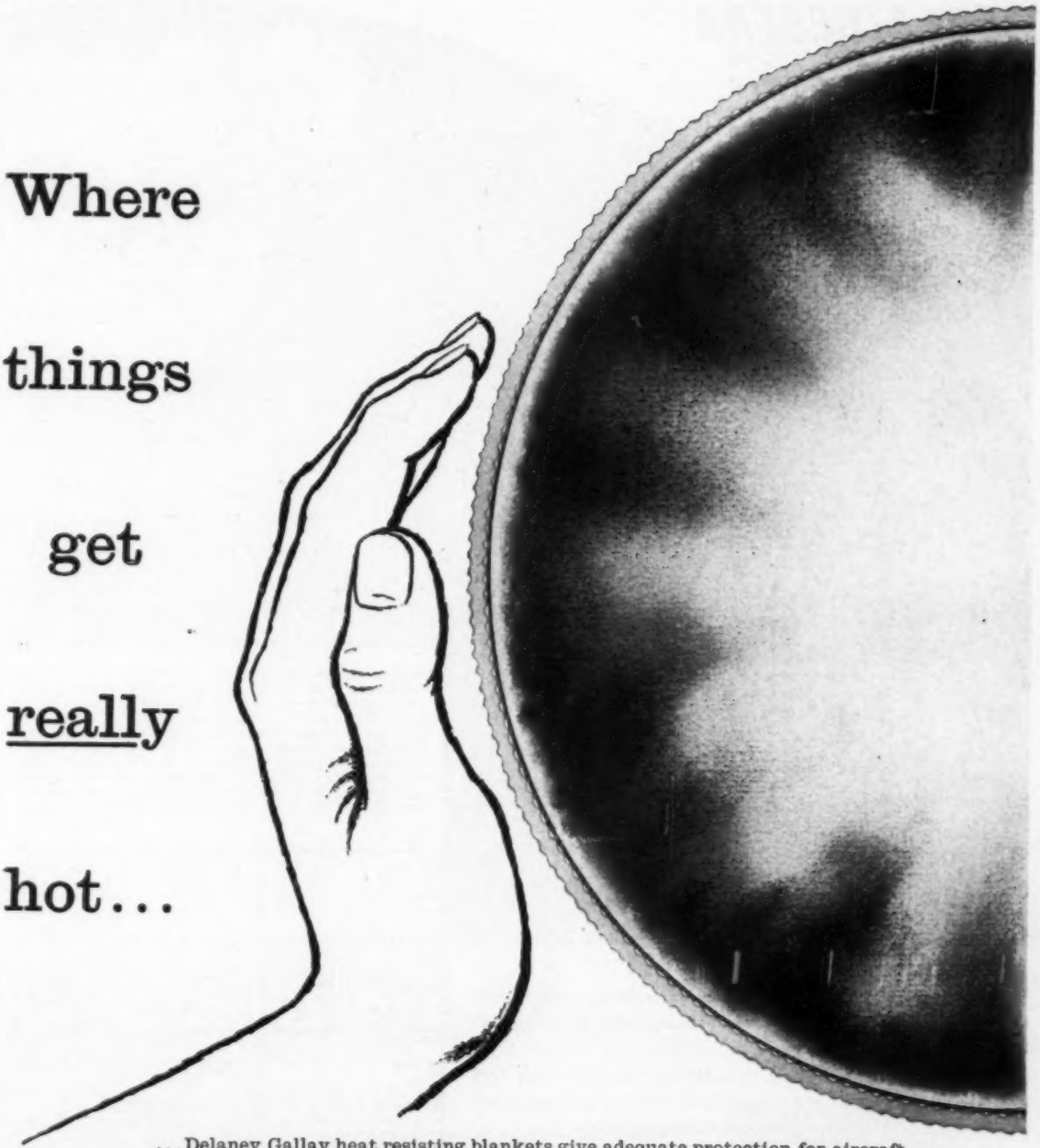
The main units of the tricycle undercarriage retract inwards hydraulically; the main wheels have 32 × 8.8 tyres inflated to 70 lb/sq in and Goodyear single-disc brakes. Slotted flaps are fitted to the one-piece wing and the whole structure is stressed for gust loads exceeding 40ft/sec (Cessna claim that the aircraft can be "flown through frontal activity using normal transport practice"). Electronic equipment is contained in a compartment behind the flight deck; provision can be made for all standard airline radio and navigational equipment, as well as for weather radar and for autopilot servos on all three axes. A 50 amp, 24 V generator is mounted on each of the four engines and on the auxiliary gas-turbine in the fuselage.

Flight testing is now almost complete. The aircraft has flown to above 24,000ft, encountered temperatures of −30 deg F and moderate icing conditions. With three engines at METO power and one outboard engine cut, rudder trim can counteract yaw down to 118 knots with the pilot's feet on the floor; in the landing configuration no pilot effort is necessary to avoid yaw or rolling tendencies before the pitching moment occurs at 78 knots I.A.S. A production line is to be established within 90 days and the first delivery (no orders have



Cessna Model 620 (four Continental GSO-526-A); above, schematic view of Model 620 interior.

Where things get really hot...



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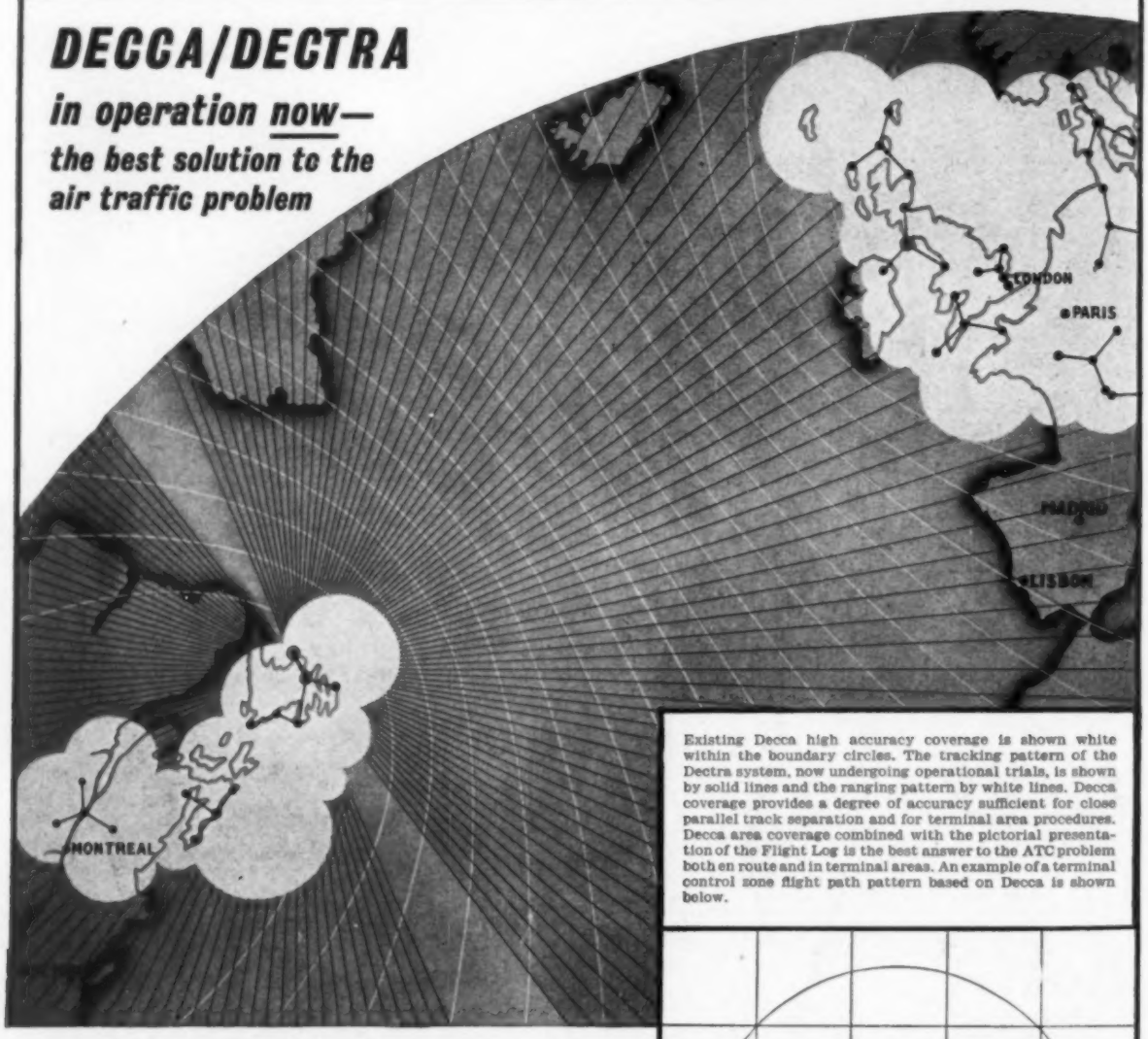
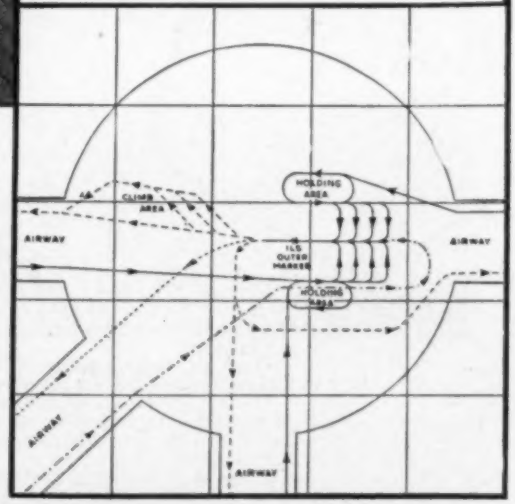


Existing Decca high accuracy coverage is shown white within the boundary circles. The tracking pattern of the Dectra system, now undergoing operational trials, is shown by solid lines and the ranging pattern by white lines. Decca coverage provides a degree of accuracy sufficient for close parallel track separation and for terminal area procedures. Decca area coverage combined with the pictorial presentation of the Flight Log is the best answer to the ATC problem both en route and in terminal areas. An example of a terminal control zone flight path pattern based on Decca is shown below.



Precise control of air and sea traffic can be accomplished today by the use of Decca/Dectra the proven high accuracy area coverage system.

DECCA/DECTRA is the only navigation system providing high accuracy local coverage at any altitude with medium and long range parallel track facilities using the same airborne equipment.

DECCA/DECTRA is the only system which provides pictorial presentation.

DECCA/DECTRA is the most economical system in the world both in cost and in use of frequencies.

The report of the Jet Operations Requirements Panel of ICAO meeting in Montreal in June 1957 has this to say:

"The Panel recommends the adoption of an accurate and reliable short-range navigational aid based on the area coverage system and designed to provide pictorial presentation to the pilot in the cockpit. The Panel further recommends that the Sixth Session of Communications Division should consider this recommendation as a matter of urgency."

Over 4,000 ships and aircraft are fitted with the Decca System which has been in operation for over 11 years.

DECCA/DECTRA

the world's most accurate navigation system

The Decca Navigator Company Ltd London

Business and Touring Aircraft . . .

yet been announced) is scheduled for next March.

182 First announced in March last year, the 182 is virtually a 180 with additional soundproofing, a revised powerplant installation, and a steerable nosewheel undercarriage. Accommodation and equipment are generally similar to those of the Model 172.

180 Last of the Cessnas to retain a tailwheel, the Model 180 is similar to the 170/172 series except for an increase in power and a fractional increase in overall length and gross weight. Standard equipment includes castering wheels and the aircraft is also available as a floatplane or an amphibian.

172 Introduced in November 1955, the Model 172 is probably one of the easiest aircraft to fly in the world; it is regularly sold to people with no previous flying experience who, with the assistance of a certified instructor, qualify on the 172 after their first few days of ownership.

Powered by a 145 h.p. flat-six engine, the 172 has two adjustable seats at the front and a bench for two at the rear, and the interior is lavishly furnished, soundproofed and very fully equipped with such items as coat hangers, a cigarette lighter, windshield de-frosting and cabin heating.

Like all Cessnas, the 172 has an all-metal, flush-riveted airframe with exceptionally low drag. Wings are provided with high-lift slotted flaps and a stall-warning system, and the undercarriage comprises a "Land-O-Matic" main gear with spring-steel suspension and disc brakes, and a fully steerable nosewheel with which the aircraft can be turned round on a taxi-strip less than 30ft wide. Some thousands of Model 172s are at present in service, and production is in excess of 50 per week.

310 In this light twin, the prototype of which flew in January 1953, Cessna have combined high performance, advanced engineering design, luxurious furnishing and outstanding "styling," and they claim the Model 310 to be "the world's best all-round light twin."

The interior, which can be furnished in "gold, copper or turquoise" colour combinations, seats five, there being individual seats for two at the front. Current Model 310B aircraft have an advanced U.S.A.F.-type instrument panel (the aircraft is used by that service as the L-27A) with red post lighting and individual rheostat groups. Other equipment includes retractable steps, complete soundproofing and air-conditioning, a five-port oxygen system, a 19 cu ft baggage hold accessible from inside or outside the aircraft, and a very extensive range of controls and instrumentation.

All fuel is contained in permanently attached tip-tanks, each of which houses a flexible cell with a capacity of 41.6 Imp. gal. An optional extra is the fitting of auxiliary cells in the outer wings. There are two electrically driven fuel pumps and two pumps driven by the flat-six engines, the latter being enclosed in special low-drag cowlings and driving two-blade constant-speed feathering propellers. The undercarriage and split flaps are operated electrically.

Several hundred 310s are in service in all parts of the world—an example was flight-tested by us for our issue of September 9, 1955—and production is about one per day.

CH-1A This is the C.A.A.-certificated version of the U.S. Army H-41 two/four-seat utility helicopter. Powered by a supercharged flat-six engine mounted in the nose, the CH-1 has a transmission designed for 3,000-hr overhaul periods and a rotor-head assembly designed for more than 1,000 hr. Details are given in the table of data on p. 596. Military production is beginning and the commercial version will be marketed next year.

Cessna Aircraft Co., Wichita, Kansas.

Champion

Traveler In 1954 Champion purchased the rights to build the designs of the former Aeronca corporation, and production began the same year. The basic Traveler is a dual tandem two-seater with a tailwheel.

Traveler De Luxe Basically similar to the Traveler, the De Luxe variant is distinguished by spatted main wheels and numerous interior improvements. Among the latter are a shielded electric system, hydraulic brakes and soundproofing.

Tri-Traveler Described as the cheapest nosewheel aircraft on the American market, this machine incorporates all the features of the Traveler De Luxe with the advantages of a nosewheel undercarriage. An extensive range of factory-installed extra equipment is available for all Champion aircraft, including V.H.F. radio, L.F. A.D.F., Omnigator, Superhomer, rotating beacon, a stall-warner and twin-float undercarriage.

Champion Aircraft Corp., Osceola, Wisconsin.

Clark

1000 At present undergoing structural testing for C.A.A. certification, the prototype Clark Model 1000 is a particularly neat agricultural aircraft descended from the wartime Stearmans. Although powered by a relatively small engine (the 220 h.p. Continental), it has carried a payload of 1,000 lb while still operating well below its design gross weight.

Metal construction is used throughout. The fuselage is a semi-monocoque with cut-outs for the hopper between the lower wings and for the single-place cockpit at the rear. A conventional tailwheel undercarriage is fitted, the main gear comprising twin triangulated units each sprung by rubber in compression. The square-tipped wings have single-bay struts and a stressed metal skin. Flight testing began in the autumn of last year and appears to have been exemplary. At the beginning of this year the Model 1000 embarked upon full C.A.A. certification trials.

Clark Aircraft Inc., Marshall, Texas.

Colonial

Skimmer C-1 Originally developed as a spare-time project in 1947, the Skimmer amphibian first flew in July 1948. A company to produce it was formed with facilities at Sanford, Maine, and small-scale production began in 1955. In August last year a full type-certificate was granted and the first production Skimmer was delivered. Some 30 have now been built and production is continuing.

The Skimmer is a shoulder-wing monoplane powered by a single Lycoming flat-four mounted on a pylon vertically above the c.g. and driving a pusher Hartzell constant-speed propeller. There are side-by-side seats in front, with dual controls, and a rear seat facing to starboard adjacent to the baggage compartment. Throttle and pitch levers are suspended from the roof, between the large, sloping, hinged windscreen panels. For docking, the Skimmer is brought in bow-on, moored from the nose compartment and brought up so that the crew can walk out over the nose. The nosewheel-type undercarriage retracts hydraulically and the wings are fitted with slotted flaps extending over 80 per cent of the span.

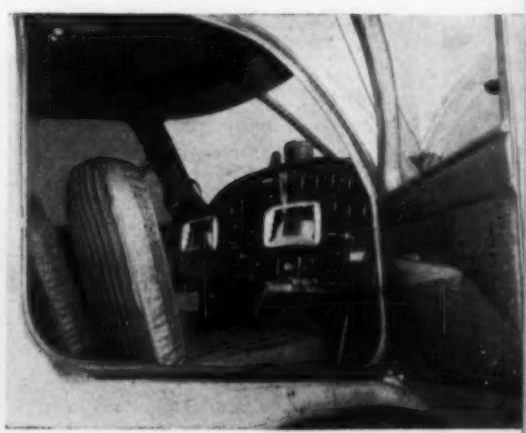
Colonial Aircraft Corporation, Sanford, Maine.

Cessna 182 (Continental O-470-L).

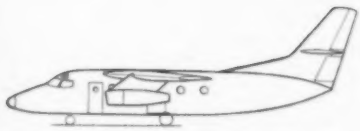
Cessna 180 (Continental O-470-K).

Cessna 172 (Continental O-300-A).

Below, Cessna 310B (two Continental O-470-M). Right, interior.



Champion Tri-Travelers (Continental C-90-12F).



Fairchild M-185 (four Fairchild J83).

Business and Touring Aircraft . . .

Fairchild

F.27 Fairchild are licence-producing the F.27 Friendship, designed by Fokker of Holland and described on page 600 under that heading. The first Fairchild-built F.27 is scheduled to roll-out from the Hagerstown plant in December and to fly in January 1958. The first delivery (to West Coast Airlines) is scheduled for March. During 1958 fifty F.27s are to be built, with a probable 60 scheduled for completion in 1959. Several of these will be specially equipped executive versions.

M-185 First announced in 1956, the M-185 is a high-wing jet transport powered by four Fairchild J83 turbojets, each of just over 2,000 lb thrust, arranged in two paired underwing pods. As the side-view drawing shows, the wing and tail surfaces are swept and the single-wheel main-gear units fold into boxes on either side of the pressurized fuselage, beneath the floor. Circular windows are incorporated into the mock-up and a typical interior provides seating for eight passengers with full pantry and toilet facilities.

The Continental Can Company placed an order for three M-185Fs in 1956 and further orders are reported to be under negotiation. The first machine, which is being financed by Fairchild funds, is expected to be completed early next year. As an interim measure it may be fitted with twin Westinghouse J34 engines.

Fairchild Engine and Airplane Corporation, Hagerstown, Maryland.

Fletcher

FU-24 Utility Typical of the recent products of the Fletcher Aviation Corporation, the FU-24 was originally designed in the winter of 1953-54 to meet the specialized requirements for top-dressing agricultural land in New Zealand. The prototype flew in July 1954 and the first production machine at the beginning of the following year. Manufacture commenced on a batch of 100 for the New Zealand market and the majority of these have now been assembled and are in operation. An accompanying photograph shows one of these aircraft in operation in New Zealand.

Fletcher Aviation Corporation, Rosemead, California.

Forney

Aircoupe Since April 1955 Forney have been responsible for the manufacture and marketing of the former Ercoupe two-seat light monoplane. Like its predecessor, the Aircoupe has co-ordinated ailerons and rudders, eliminating the need for cockpit pedals. Standard equipment includes a rear luggage compartment (in which can be fitted a child's seat), a large rear accessory shelf, foam-rubber cushions and two-tone interior furnishing, V.H.F. transmitter and receiver, soundproofing, hot and cold air supplies and flush navigation lights.

Forney Manufacturing Company, Aviation Division, Ft. Collins, Colorado.

Grumman

Gulfstream Famed for their amphibious executive aircraft of the Goose/Widgeon/Mallard series, Grumman have re-entered this market with a high-performance landplane designated Model 159 and now named Gulfstream. Powered by two Dart RDa.7/2s, the Gulfstream is somewhat smaller than the Accountant and Friendship and has correspondingly higher performance.

Primarily aimed at the business market, the Gulfstream has a pressurized cabin 31ft 6in long with an interior height of 73in. A typical executive interior makes provision for twelve seats, but at least 30 passengers could be carried in a conventional transport rôle. In any case, Grumman intend to sell the aircraft unfurnished and to allocate to distributors the responsibility for the furnishing and equipment of the aircraft with radio and navigation aids and special accessories. Grumman are at present manufacturing two prototypes and work is being accelerated to enable the first to be completed next May.

Grumman Aircraft Engineering Corp., Bethpage, Long Island, N.Y.

Helio

Courier Bearing the company designation H-391B, the Courier was designed six years ago to exploit its sponsors' ideas for an aeroplane with exceptional short-field performance, great safety (and virtual freedom from stalling) and a low noise level. After experimenting with a converted Piper airframe the Courier was planned completely from scratch, and although it is superficially conventional it is in reality quite unusual.

The constant-section, unbraced wing, of all-metal construction with fabric-covered ailerons, is provided with high-lift slotted flaps over 74 per cent of the span and with automatic slats over the entire leading edge. Unlike other slow-speed aircraft, the Courier has no fixed tailplane; instead it is provided with a variable-incidence "slab" tail with a span of 15ft. The cabin is entered by large doors, on the port side forward and to starboard at the rear. There are two pairs of seats which, with their mountings and surrounding structure, are stressed to recommendations of the Flight Safety Foundation. At the rear is a 200 lb baggage compartment; and, by removing the rear pair of seats, a compartment 6ft in length is made available, capable of taking a maximum load of 1,000 lb.

Couriers are manufactured in Kansas by the Helio-owned Mid-States Manufacturing Corporation; the type is also subject of an agreement with Fleet Manufacturing of Port Erie, Canada, who hold rights for the British Commonwealth. A number of those recently delivered are twin-float versions.

Helio Aircraft Corporation, Norwood, Massachusetts.

Hiller

12-C Of the very large number of helicopters delivered by the Hiller Company the vast majority are of the basic 12-C model, although this designation strictly applies only to the commercial version. The 12-C has side-by-side seating for three persons enclosed by a bubble-type canopy providing unobstructed vision in all directions except directly to the rear. Dual control can be provided, with cyclic-pitch levers coming out of the floor and collective-pitch levers mounted on the left-hand side of the centre and port seats. Behind the starboard (passenger) seat is a large pocket for maps and other documents. The model 12-C can readily be adapted for agricultural operations using dusting, spraying or aerosol equipment; other optional fittings can equip the machine for air-to-ground broadcasting with loudspeakers or for heavy freight operations using a load sling and external net.

The fuselage is fabricated from metal sheet stressed to form a semi-monocoque platform supporting the unstressed cabin structure and the powerplant. To the rear of this platform is attached the tail boom, of beaded metal sheet, which is braced to the base of the rotor shaft by a diagonal tube enclosing the drive to the anti-torque tail rotor. The main rotor has two blades of solid wood laminations covered with glass-fibre and provided with a stainless-steel leading edge. The Franklin six-cylinder engine is mounted with its crankshaft vertical and is cooled by a fan. Various types of landing gear can be provided, including wide tread skids (with or without small wheels to facilitate ground handling), four wheels or two rubber pontoons.

Hiller Helicopters, Palo Alto, California.

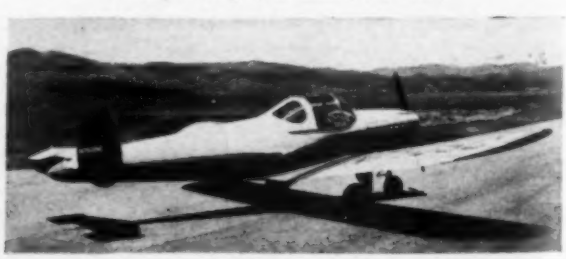
Howard

Super Ventura Described by its producer as "leading all other executive aircraft of its type in sales," the Super Ventura is, as its name implies, a conversion of the Lockheed PV-1 Ventura patrol bomber of World War 2. The entire airframe is completely re-worked to reduce drag and provide for better internal accommodation, greater fuel capacity and a more efficient engine installation.

Powered by twin Pratt and Whitney R-2800 engines in special low-drag cowlings, the Super Ventura is normally equipped for fourteen passengers and a crew of two, plus 1,500 lb of baggage. It can take this load 2,000 miles with comfortable operating reserves while cruising at no less than 300 m.p.h. at 8,000ft. The first delivery was made in May 1956; 21 have been delivered to a number of business

Fletcher FU-24 Utility (Continental O-470E).

Forney Aircoupe (Continental C-90-12F).



corporations by June of this year and deliveries are continuing.

Howard Aero Inc., San Antonio, Texas.

Lamson

Air Tractor Powered by a Pratt and Whitney R-985, the L.101 Air Tractor is a biplane of unconventional appearance designed for all kinds of agricultural work including dusting, spraying, seeding, fertilizing and weed killing. The fuselage, which is of surprisingly good aerodynamic form, is of welded steel-tube covered with aluminium sheet. The equal-span wings comprise inboard metal stubs, the upper pair of which are raked upwards to give a gull-wing effect, and interchangeable wood and fabric outer panels each provided with an aileron and a large end-plate. The pilot is seated well aft, to the rear of the 15 cu ft hopper which has a maximum capacity of 2,000 lb. The prototype Air Tractor flew at the end of 1953 and the first production machine one year later.

Lamson Aircraft Company Inc., Seattle, Washington.

Larson

D-1 First flown on March 30, 1956, the Larson D-1 Agricultural Biplane has been developed as an easily maintained aircraft—with a very low capital cost—for general-purpose spraying duties. Among the novel features are: use of car wheels, tyres and brakes; uncovered rear fuselage; power package removed from war-surplus Stearmans; twin rudders which also serve as fins; cockpit placed behind the load; four ailerons all mounted at mid span; and a tail wheel unit comprising a standard industrial 14in tyre mounted on parallel leaf-springs. Flight test results have been outstandingly successful and the production schedule is at present being prepared.

Larson Aero Development, Concord, California.

Lockheed

JetStar Designed and built in 241 days from the beginning of this year, the Lockheed CL-329 JetStar is the first aircraft to be designed to meet the UC-X specification issued by the U.S. Air Force for a combat-readiness crew trainer and executive transport. As such it has obvious potential as a commercial or business machine and is to be marketed as such from the summer of next year.

The fuselage is pressurized to 8,000ft equivalent at 45,000ft and has an interior width from 75 to 79in, an aisle headroom of 74in and a usable length of 28ft behind the flight deck. For freight purposes the 716 cu ft available can be loaded at 7.5 lb/cu ft with 25-per-cent voids; for express service, with an 18in aisle and cargo bins, off-load density is 10 lb/cu ft. As a passenger transport many furnishing layouts are available (see diagram, p. 592) but the standard interior provides for a crew of two, ten passengers and full pantry and toilet facilities.

As a utility cargo carrier the JetStar can carry a maximum payload of 4,000 lb, and its high cruising speed is sufficient to generate the remarkable work-capacity of 814 ton-knots for a range of 1,500 nautical miles. The entire floor is patterned with sockets for stanchions and recessed rings, and wall rings are provided for the attachment of bulkhead nets at various stations for solid cargo loading. In addition, provision is made for a ditching barrier at the forward end of the usable floor, the latter having removable panels inserted over the aisle troughs (which increase headroom between the seat rows).

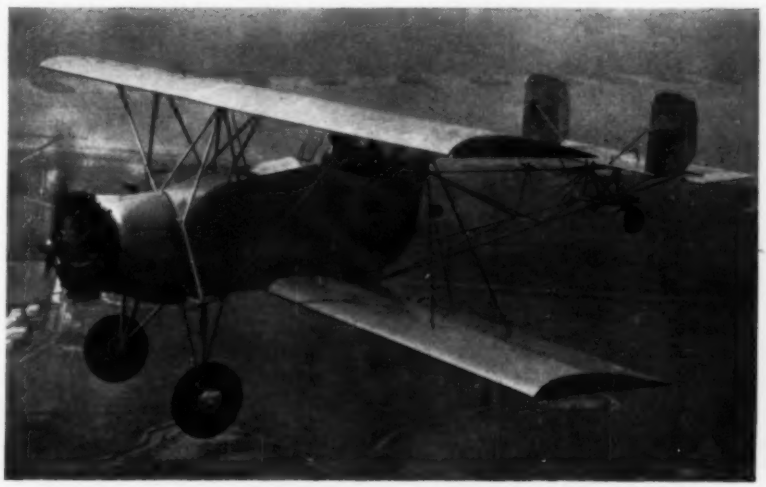
Lockheed have recently released details of the accessory systems. Flying controls for the rudder and elevator are manual with aerodynamic tabs, whereas the aileron system incorporates duplicated hydraulic boost systems. Longitudinal trim is obtained by electrically adjusting the incidence of the all-moving tailplane. The high-lift flaps are extended hydraulically and the wings are fitted with automatic slats over the entire leading edges. Electrical power is generated by a pair of 350-amp starter/generators feeding 12-V D.C. batteries. There are two completely separate hydraulic systems each supplied by a variable-displacement engine-driven pump. The aileron boost is coupled to both systems, and other essential services may be selected through either main or stand-by systems. A diluter-demand oxygen system is provided for the pilot and co-pilot, and the main air-conditioning system—the centralized units for which are accessible through the dive-flap door—employs air-cycle refrigerating and can be used for ground cooling.

Standard equipment in the very attractive flight deck includes an MA-1 Flight Director system, provision for weather radar, autopilot controls and the following radio equipment: ARN-31 glide slope and I.L.S., ARN-14 Omni, ARN-6 A.D.F., ARA-26 keyer, ARC-10 intercom., ARC-12 V.H.F. and ARC-34 U.H.F.

The propulsion system, which is mounted on the flanks of the rear fuselage, comprises either two Wright TJ-37s (Bristol Orpheus development) or four General Electric J85s. Fuel is contained in integral tanks extending from the wing-root rib to the tip, the system being filled at 167 Imp. gal/min through a pressure connection in each wing. Jettison pipes are provided at the wing tips. Total capacity is 1,365 Imp. gal, and this can be supplemented by a pair of 250 Imp. gal underwing slipper tanks arranged like those of the Comet 4. New data are given in the table on page 597 and an exclusive cut-away drawing was published in our issue of September 20.

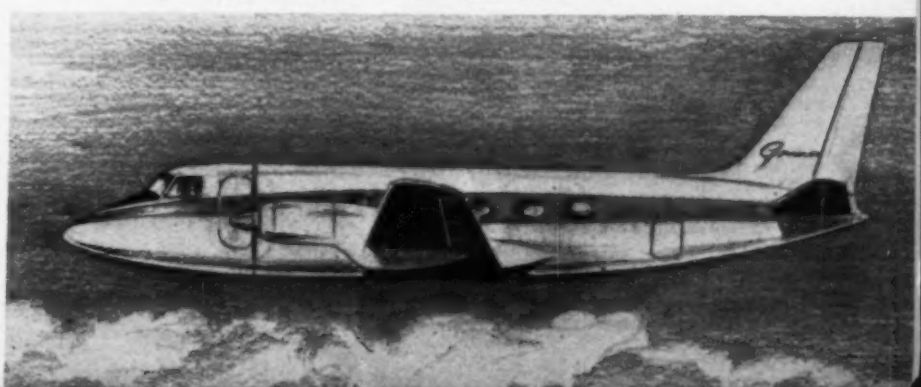
Lockheed Aircraft Corporation, Burbank, California.

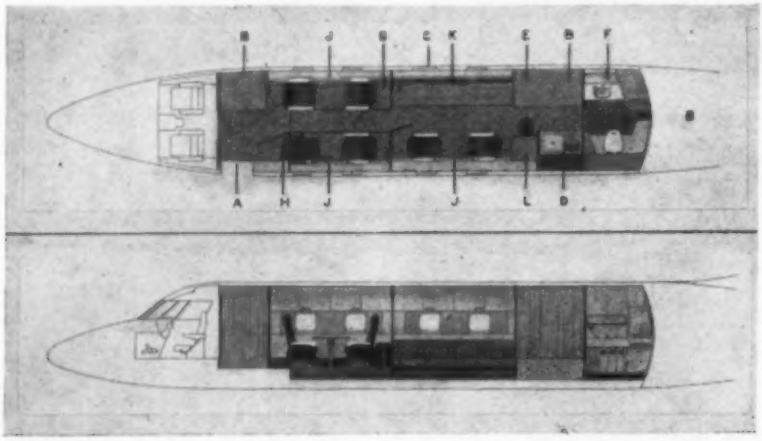
Hiller 12-C (Franklin 6V4-200-C33).



Larson D-1 (Lycoming R-680).

Grumman 159 Gulfstream (two Rolls-Royce Dart RDa.7/2).





Above and below are a photograph of the prototype Lockheed CL-329 JetStar (two Wright TJ-37 or Bristol Orpheus, or four G.E. J85) and a diagram of a typical executive interior. Key to the latter: A, cabin door; B, baggage; C, emergency exit; D, galley; E, coat space; F, toilet; G, life raft; H, jump seat; J, berth seat; K, lounge berth; L, desk.

Business and Touring Aircraft . . .

Mooney

Mark 20 Certificated in August 1955 the Mark 20 is a four-seat low-wing aircraft of very clean design powered by a Lycoming flat-four driving a constant-speed propeller. The soundproofed cabin has individual seats at the front and a bench at the rear, and is fitted with a heater and all the furnishings which one would expect to find in an American aircraft (such as ashtrays, heating, foam-rubber cushions, coat hangers and curtains). The airframe is manufactured from pressure-bonded laminated spruce "sealed for the life of the airplane similar to the famous Mosquito." The laminar-flow wings are fitted with three-position manually operated slotted flaps, and the tailplane and vertical tail pivot as a unit to provide trimming in the pitching plane.

By the middle of last month 168 Mark 20s had been produced, the current output being one aircraft every three days. At the beginning of next year one aircraft should leave the plant every two days, and a peak rate of one aircraft per working day is scheduled to be achieved by June 1 next.

Mooney Aircraft Inc., Kerrville, Texas.

National

NA-75 This aircraft is described as representing the combined efforts of pilots and operators in the agricultural aviation industry and the engineers of National Aircraft who have spent several years in research and development. The NA-75 is a combination duster/sprayer with many attractive characteristics.

Like the majority of American aircraft in this category, it is based upon the wartime Stearman. The many modified parts can be purchased from National Aircraft for the modification of existing Stearmans and the NA-75 is also marketed as a complete aircraft direct from the factory. One of the fundamentals of the design is the "Hi-Lift" wing of Göttingen 398 section with large end plates, manufactured from a metal skeleton with fabric covering attached by clips. The gross wing area of 338 sq ft allows the aircraft to fly empty at around 35 m.p.h.

The fuselage has been largely redesigned and is covered with ten metal panels secured by patented quick-release fasteners all of which can be undone in five minutes by two men with screwdrivers, to lay the whole structure bare from the firewall to the tail. In the centre is the 31.7 cu ft glass-fibre dusting/spraying hopper (both types of chemical can be loaded together and the change made from one to the other in flight). Behind the hopper is the single cockpit, and for better visibility the NA-75 is designed to fly nose down at all times, all instrumentation being installed in the trailing edge of the upper-wing centre section.

National Aircraft Corporation, Burbank, California.

North American

Sabreliner At present under development to meet the U.S. Air Force's UT-X specification for a twin-engined light utility jet crew-trainer and executive transport, the North American Sabreliner has obvious applications as a business aircraft. Powered by twin General Electric J85s mounted on the rear fuselage (as shown in the revised drawing at the foot of the page), the Sabreliner has an oval-section fuselage with a flight deck for two and a pressurized cabin above the wing for from four to nine passengers. The interior can be maintained at an equivalent altitude of 8,000ft at 45,000ft and oxygen is provided for each seat station. Engineering features include thermal leading-edge de-icing, pressure fuelling from a socket above the port nacelle and a centralized electronics and radio bay in the nose which can be reached without trestling. At least one prototype is being manufactured to meet the military requirement and the company state that they hope eventually to build the aircraft for commercial sale.

North American Aviation, Inc., Los Angeles 45, California.

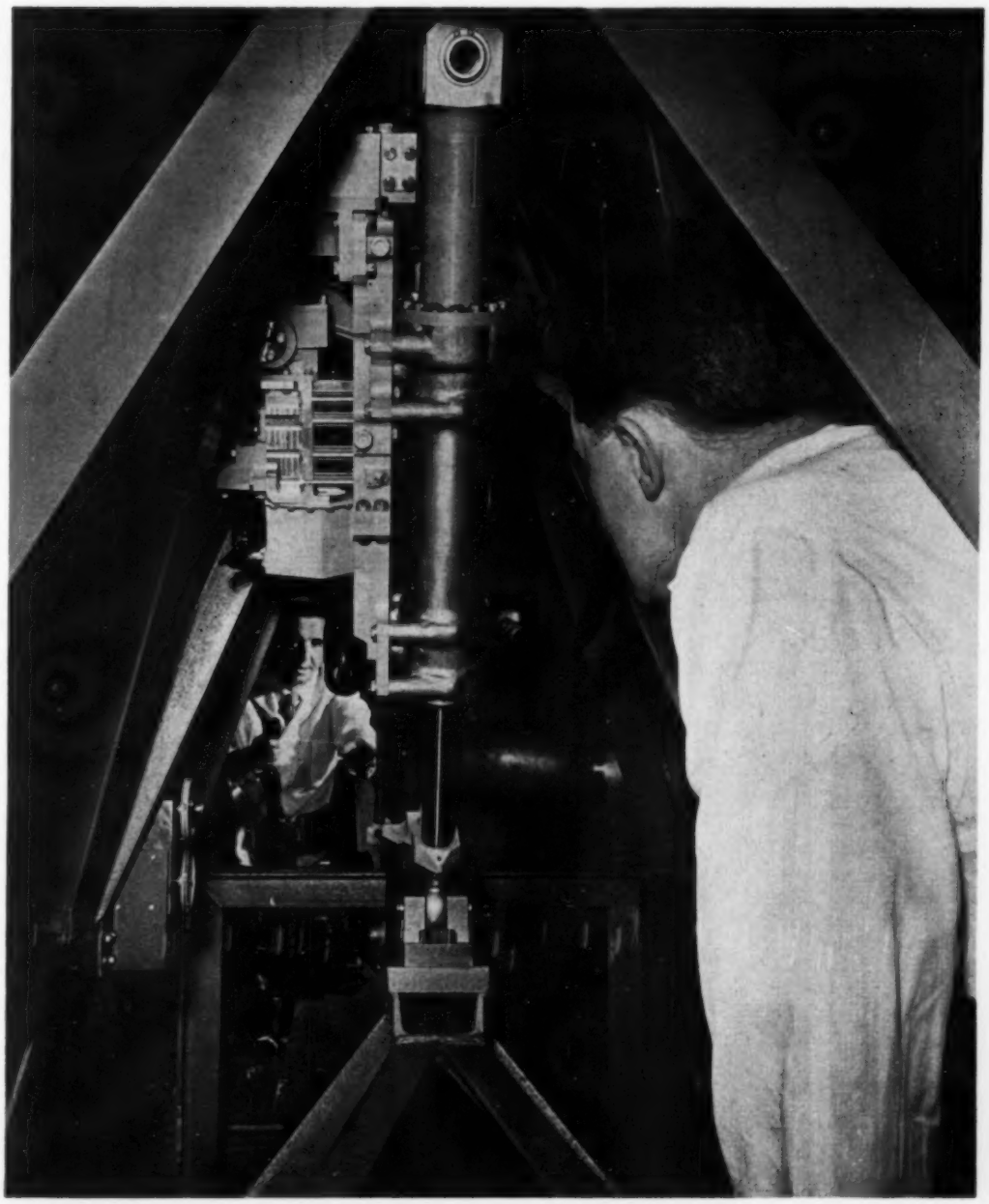
Northern

Cruisemaster Originally designed by Bellanca, the well-known Cruisemaster four-seat, low-wing cabin monoplane is now being produced by Northern Aircraft, who have purchased the design, certification, patents, tools and jigs. Powered by a 230 h.p. flat-six Continental driving a constant-speed two-blade propeller, the Cruisemaster has a retractable

(Below) Mooney Mark 20 (Lycoming O-320).

(Below) National NA-75 (various engines).

Below, artist's impression of North American Sabreliner (two General Electric J85).



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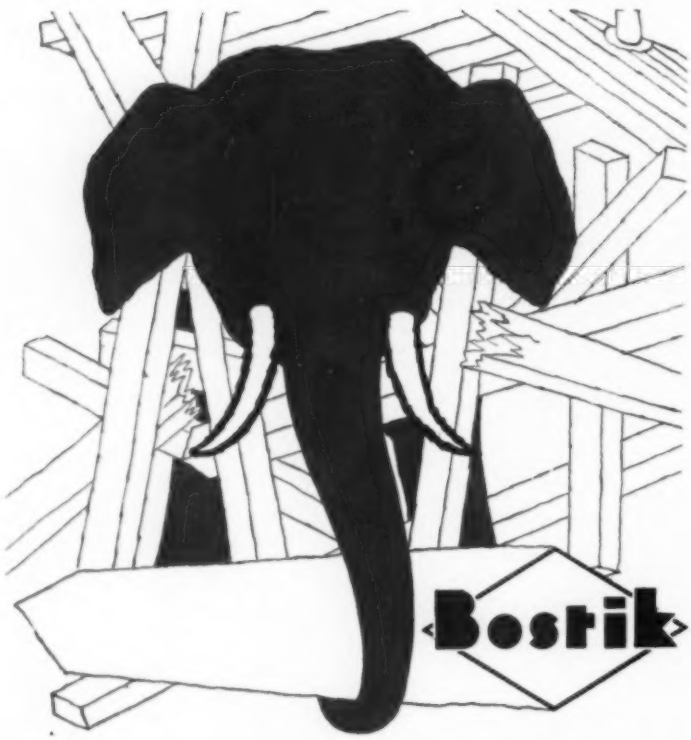

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tailwheel-type undercarriage and is distinguished by twin auxiliary fins on the tailplane. Total fuel capacity is 45 Imp. gal and the cruising speed approaches 200 m.p.h. Some $250,000 has been locally subscribed for the production of the Cruisemaster and Northern expect to sell 75 to 100 units per year.

Northern Aircraft Inc., Alexandria, Minnesota.

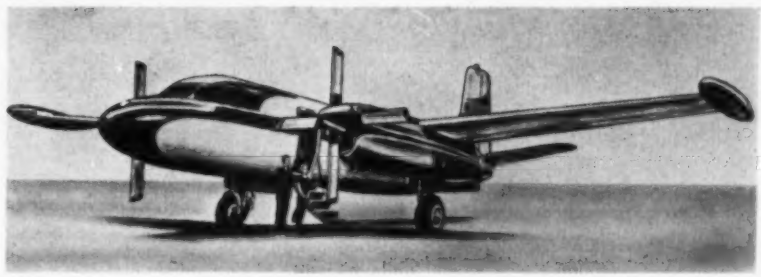
On Mark

450 Based on the Douglas B-26 Invader, itself an established "corporate" type, the On Mark Model 450 is a projected high-speed executive transport powered by two Allison 501D turboprops similar to the powerplants of the Lockheed Electra. Production of each aircraft virtually involves fabrication of a complete airframe from scratch. In particular the fuselage is completely new with a cylindrical cross-section 90in in diameter, with AiResearch cabin-conditioning and pressurized to an equivalent cabin altitude of 5,000ft at 30,000ft using engine-driven blowers. The standard interior will seat fourteen passengers.

Owing to the high cost of the Allison engine, it is possible that complete powerplants may be leased to operators on a per-hour basis; this is expected to reduce the purchase price of the aircraft from $1m to about $800,000. Flight testing of the first aircraft should begin next summer and the first customer (Maytag Aircraft Corporation) are scheduled to take delivery of the first production Model 450 early in 1959. On Mark expect thereafter to produce two aircraft monthly for 60 months.

On Mark also market re-engined B-26 Invaders for executive purposes. In these the rear wing spar is eliminated, to increase the cabin length and height and permit the entrance door to be situated on the starboard side instead of beneath the floor. Nineteen surplus B-26s were recently purchased from the U.S. Air Force and a number of these will be used for making up kits and basic parts for the new turboprop Model 450.

On Mark Engineering Co., Van Nuys, California.



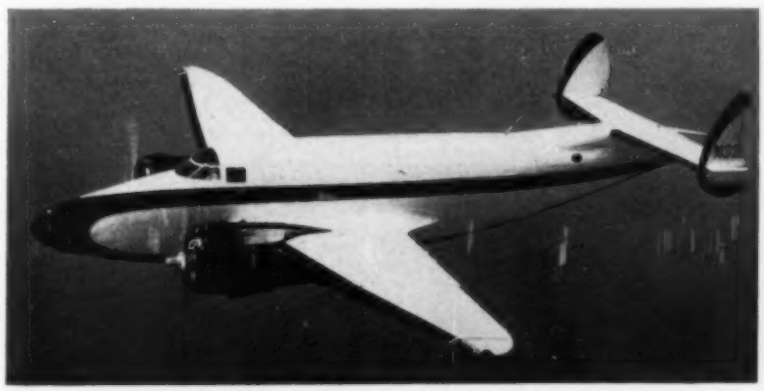
On Mark Model 450 (two Allison 501D).

PacAero

Learstar In 1953 the Aircraft Engineering Division of Lear Inc. was formed to market a very much improved version of the Lockheed Lodestar twin-engine transport. The first prototype Learstar flew in May 1954 and the production type was certificated early in 1955. Since then numerous Learstars have been delivered to all kinds of corporate customers. The Lear A.E.D. has now been purchased by PacAero Engineering Corporation and is in business under the latter name.

Production is in hand upon two marks of Learstar, the Mk 1 with 1,425 h.p. Wright R-1820-76A, -76B or -86 engines and the Mk 2 with 1,350 h.p. Wright R-1820s of earlier models. As an accompanying photograph shows, the Learstar is a fine-looking aircraft, and it has an extremely efficient aerodynamic form giving very low drag and a cruising speed of approximately 300 m.p.h. at a consumption rate of just over 2¼ miles per Imperial gallon. Within the space limitations of the basic Learstar fuselage a customer can have any specified interior configuration and furnishing; typical executive aircraft have a crew of two and seats for from eight to twelve passengers. Nearly all the Learstars so far delivered have been fitted with dual control, extensive duplicated radio and navigation aids; weather radar is available as an optional equipment (which increases the length of the nose by 4ft 6in).

PacAero Engineering Corporation, Santa Monica, California.



PacAero Learstar Mark I (two Wright R-1820-76).

Piper Comanche (Lycoming O-360).

Piper

Comanche With this extremely neat four-seater Piper have broken away from their classic single-engined family and entered the realm of all-metal aircraft with retractable tricycle undercarriage and every modern refinement. Powered by the new 180 h.p. Lycoming four-cylinder engine, the Comanche embodies a number of aerodynamic refinements unusual for a light aircraft, including a laminar-flow wing, a swept vertical tail and a single-piece "slab" horizontal tail.

The first Comanche flew on May 24 last year. C.A.A. type-certification was carried out on one of a pair of Comanches which have undergone protracted and exhaustive flight and service testing. The production line has now taken shape and most tool work and major jigging has been completed to provide for a high rate of production. The first production Comanche is now complete (it is illustrated below), although the first eight off the line will be retained by Piper for further accelerated field-testing and demonstration flying. Public interest is reported to be quite exceptional, and Piper's world-wide distributors—Irish Air Charter handle sales in the U.K.—expect this aircraft to keep them very busy.

Apache During the past three years this light twin has become widely accepted both within the U.S.A. and in other countries, and the 1,000th was delivered in the summer of this year. Approximately 40 have been ferried across the Atlantic to purchasers in Europe and Africa, and one of these was flight-tested by us for our issue of August 19, 1955. Production continues at the rate of about two per day.

Powered by a pair of Lycoming flat-four engines driving constant-speed feathering propellers, the Apache is normally a four-seater, but a five-seat version is available by replacing the twin rear seat by three individual seats on tracks. One of these seats occupies the left side of the 25 cu ft baggage compartment which is then fully upholstered and becomes an integral part of the cabin. In this year's Apaches additional soundproofing and a rubber-backed floor mat reduce interior noise level. Other changes include a completely new instrument panel and control pedestal, higher capacity carburettor heaters and air-temperature indicators.

The tricycle undercarriage retracts hydraulically (with emergency pneumatic operation) and fuel is housed in two flexible wing cells with an aggregate capacity of 60 Imp. gal; the Super Custom Apache has a total tankage of 90 Imp. gal, sufficient for a range of 1,200 miles, and this model is also distinguished by the fitting of dual vacuum pumps. Factory-installed radio equipment can include Lear A.D.F., Narco Omnigator (combining V.H.F. transmitter, receiver, 75 Mc/s marker beacon and I.L.S. localizer function) plus a separate Narco 27-channel transceiver.

Tri-Pacer One of the most popular light aircraft in the world the Tri-Pacer is a four-seater powered by a Lycoming flat-four driving a fixed-pitch or controllable propeller. Nearly two-thirds of the current production is of the Super Custom model. This version includes very full instrumentation; gyro and other flight

Piper Apache (two Lycoming O-320). Above, right, Apache cabin.

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instruments are grouped in a panel in front of the pilot, radio equipment (including Narco Superhomer, V.H.F. receiver and V.O.R.) and engine instruments are positioned centrally and space is provided for extra equipment to starboard. Standard fuel capacity is 30 Imp. gal, and this can be extended with an optional 6.6 gal auxiliary tank under the rear seat to give a range in excess of 600 miles. Total production of the Tri-Pacer is now 6,000.

Super Cub Bearing the company designation PA-18, the Super Cub is a tandem two-seater directly descended from the L-4 Grasshopper and the famous J-3 Cub, production of which totalled 19,798 aircraft. Most important of this family at present is the PA-18-A agricultural duster and sprayer, of which more than 1,500 are in world-wide service. The fuselage has been modified to accommodate an 18 cu ft aluminium tank housing 500 to 1,000 lb of solid or 92 Imp. gal of liquid insecticide. As an accompanying photograph shows, this load is discharged either through a central non-clogging hopper or from underwing spray booms under the pressure of a pump driven by a ram-air fan beneath the engine. This aircraft was described in our issue of January 11, 1952.

PA-25 Under this designation Piper are developing a single-seat multi-purpose agricultural aircraft. It is believed to be a low-wing, all-metal design, powered by a single piston engine.

Piper Aircraft Corporation, Lock Haven, Pennsylvania.

Potter

YC-97 Early examples of the Boeing C-97 Stratofreighter are becoming available for purchase (for prices reported to be as low as $36,000) from the Air Materiel Command of the U.S. Air Force. Two of the first YC-97s have been converted for spraying operations by Potter Aircraft, the big Boeings being owned by DeLong Aircraft and used by the U.S. Department of Agriculture.

Undoubtedly the largest agricultural machines in the world, they are each equipped with nine B-25 ferry tanks each with a capacity of 500 Imp. gal. Insecticide is fed at a maximum rate of more than 400 Imp. gal/min to 40ft spray booms beneath the wings. Flying at 200 m.p.h., some 200ft above the treetops, the YC-97s have been spraying D.D.T. against gipsy moths, covering approximately 12,000 acres per hour each (including time taken in ground operations). "Wet"-operation charter rate is $450 per hour.

Potter Aircraft Co., Burbank, California.

Sikorsky

S-55 Well over 1,000 of these familiar helicopters have been delivered by the parent Sikorsky company, and many are used by airlines and business operators; in particular a large number are used by American oil companies, and the work of these aircraft has frequently been illustrated in our pages. Most S-55s in commercial service have the 600 h.p. Pratt and Whitney R-1340 Wasp engine and carry a gross useful load of 2,405 lb. Various interior arrangements provide for up to ten seats and the helicopter is available with pontoons for water or amphibious operation. A typical price is $147,500.

S-58 More than 400 military deliveries have been made of this large single-engined helicopter, and it is now also operated by a number of airlines and other commercial concerns. Powered by a 1,525 h.p. Wright R-1820 engine, it normally seats up to twelve or fourteen (including the crew of two) and can lift a useful load of 5,140 lb. In spite of its price of $248,000, sixteen orders were placed as soon as it went on to the commercial market at the end of 1956, and deliveries are likely to continue for a considerable time.

Sikorsky Aircraft Division of the United Aircraft Corporation, Bridgeport, Connecticut.

Taylorcraft

Zephyr Although Taylorcraft's current production is but a fraction of what it was in the 1930s, manufacture of conventional high-wing monoplanes continues in two major versions. Both are powered by the Continental O-470 flat-six, driving either a constant-speed or fixed-pitch propeller. The airframes of the two versions are almost identical, and a point of particular interest is that the airframes incorporate moulded glass-fibre skinning over much of the wings, fuselage and tail.

The basic Zephyr type 400 is a four-seater with a spatted undercarriage. Dual controls are provided in front and a large baggage compartment is situated behind the rear pair of seats. The Model 20AG Topper is the agricultural variant, in which provision is made for either a dust hopper or spraying tank together with an engine-driven pump for supplying liquid insecticide to spray booms under the wings.

Taylorcraft Inc., Conway, Pennsylvania.

Temco

Riley Twin The history of this light twin is complex, and starts with the single-engined Navion (by North American Aviation) of the immediate post-war period. This design was later taken over and mass-produced by Ryan, and in April 1952 the Riley Aircraft Company completed the prototype of a twin-engined version which received a type certificate the following year. Temco began limited production of this aircraft in April 1953; in December the Texas company purchased full rights to the design, and early in 1955 they introduced an improved version a few of which are still available from the company's plant at Greenville, Texas.

Below, Piper PA-18-A (Lycoming O-320).

Powered by two Lycoming flat-fours, driving constant-speed feathering propellers, the Temco Riley Twin is a low-wing all-metal machine with a retractable nosewheel-type undercarriage. The conventional four-seat cabin is enclosed by a large canopy which slides to the rear in the manner of many fighters; with wing-tip tanks, giving a gross fuel capacity of 120 Imp. gal, the Twin can fly 1,200 miles, cruising at 170 m.p.h. at 7,000ft.

Temco Aircraft Corporation, Dallas, Texas.

Transland

Ag-2 Five years of steady development preceded the manufacture of the Ag-2, which first flew in October last year. It culminates the design philosophy reflected in the experimental Ag-1 built at the Texas A. and M. college. The airframe is built entirely of metal. The wing, which has an area of 319 sq ft, has an extraordinarily thick high-lift section (N.A.C.A. 64021) and is provided with full-span slotted flats, the outer sections having slot lips serving as ailerons. When flying light this flap system can be depressed (with synchronized automatic tailplane trim) to keep the aircraft controllable down to below 50 m.p.h. The fuselage is completely skinned, and is protected over its inter-

Piper Tri-Pacer (Lycoming O-320). Right, Tri-Pacer interior.

nal surfaces with "catalytic" zinc-chromate primer to protect it against corrosive chemicals. The undercarriage has oleo shock absorption, and wire shears are attached to the struts. Power is provided by a Pratt and Whitney R-985, driving a two-position propeller and fed with fuel from wing tanks.

The enclosed cockpit is mounted to the rear of the payload areas which extend forward almost to the firewall. Separate dispensing systems are provided for solids and liquids, both of which can be controlled (either singly or together) in flight. A liquid-tight hopper is provided for 2,000 lb of low-density solids (volumetric capacity is 53 cu ft) and four wing tanks are provided for a total of 208 Imp. gal of liquid insecticide. Other equipment includes an agitator gate, spreader, engine-driven pump, valves and spray booms.

With a useful load of almost 3,000 lb (the same as the empty weight) the Ag-2 is exceptionally efficient and is probably near to the ultimate of what can be achieved on 450 h.p. At 58 per cent power it can fly at 80 m.p.h. at full load with the flaps down, and yet can cruise continuously at 142 m.p.h.

Transland Company, Torrance, California.

Trecker

Gull This Milwaukee company imports from Piaggio (Italy) complete P.136 amphibian airframes, of the type described on p. 600. They then fit them with powerplants and with various types of interior, according to customer requirements. The aircraft is marketed in two versions. The Trecker Royal Gull is the basic aircraft, powered by Lycoming 270 h.p. engines; the Super Gull 200 is essentially the same machine, but is fitted with supercharged Lycoming GSO-480-A1A6 engines. It sells for $89,925.

Trecker Aircraft Corpn., Milwaukee, Wisconsin.

Vertol

43 Although expensive, the Vertol single-engined, twin-rotor helicopter (of which many hundreds have been delivered for military operations as the H-21) is expected to prove a commercial success when it is introduced next year. The commercial version is designated Model 43 and it will be marketed at a price ranging from $275,000 to $300,000 depending on equipment and furnishing.

Powered by a 1,425 h.p. Wright R-1820 engine geared to both fore and aft rotors, the Model 43 will provide seating for from 16 to 19 passengers in addition to a crew of two in the glazed nose cockpit. Maximum useful load is 5,200 lb and the cruising speed 100 m.p.h. at the gross weight of 14,000 lb. As a follow-on, it is intended that the Model 43 will be succeeded by a turbine-driven version powered by two 1,000 h.p. General Electric T58 engines, which would provide the aircraft with twin-engine reliability. Sales agents have been appointed throughout the world, that for the United Kingdom being Rotorwings of London.

Vertol Aircraft Corporation, Morton, Pennsylvania.

Wold

Many hundreds of converted military aircraft and former airline transports are in daily use in the U.S.A. by business houses and other executive operators. Although possibly expensive to operate from the viewpoint of ton-miles per gallon, these aircraft offer rapid and reliable transport for from six to twenty passengers (these are typical figures) in great comfort at cruising speeds which may be as high as 300 m.p.h. The majority of these machines are lavishly equipped and are provided with a great array of radio and navigational aids and frequently with weather radar. None of these aircraft are currently being produced by their original manufacturers but there are many firms which specialize in their conversion and marketing to customer requirements. The following four aircraft, marketed by a well-known New York company, are typical of this class of business aeroplane.

Above, Transland Ag-2 (Pratt and Whitney R-985 Wasp Junior).

Right, Wold-engineered Lockheed Ventura (two Pratt and Whitney R-2800 Double Wasp).

DC-3 The majority of these familiar workhorses were originally built by Douglas as U.S.A.F. C-47s, and they are becoming available from both airlines and military services. A recent executive DC-3 marketed by Wold is lavishly equipped for fourteen passengers in a cabin equipped with oxygen system, an A.M. radio receiver, diffused overhead lighting, a telephone to the pilot, and an indicator panel for a.s.i., altimeter, clock and outside/inside thermometer. Very considerable baggage space is provided, together with a fully equipped pantry and one fixed desk and two retractable tables within the cabin.

Powered by a pair of Pratt and Whitney R-1830-75 engines, each of 1,200 h.p., the aircraft is equipped with a Sperry A-12 autopilot and approach coupler, together with the following radio equipment: ARC-5 V.H.F. transmitter; two ARN-7 A.D.F. receivers; Bendix 53B marker beacon receiver; two 149F inverters; Collins 51R V.H.F. receiver with Omni; Collins 17L transmitter; ARC-15B Omni; TA-1B transceiver; ARN-5 I.L.S. receiver; and ARC F-11 amplifier.

Lodestar Although not subject to the extensive airframe modification of the Learstar (p. 593) typical Wold Lodestars are sumptuously furnished, a recent example seating eight passengers in a cabin provided with fully adjustable heating, oxygen at each seat, double "picture windows," toilet, hot and cold running water, large pantry and bar and ample storage space. This aircraft is powered by two Wright R-1820-704C9GC engines, and is equipped with the following devices: Sperry A-12 autopilot and approach coupler; Bendix X-band radar; full de-icing; and very comprehensive radio and navigational equipment.

Ventura Originally produced by Lockheed as the military derivative of the Lodestar, the Ventura is much more powerful, being equipped with two Pratt and Whitney R-2800-31 engines each of 2,000 h.p. The interior of a current Wold-marketed Ventura is equipped as an executive suite for eight persons; features included "plush reclining full-swivel seats upholstered in heavy grain fabric . . . a huge 7ft divan . . . carpeting of grey broadloom . . . removable work desk in golden mahogany . . . galley with warming oven, hot cups, snack bar and ice cabinet . . . plus huge panoramic windows." A Sperry autopilot with altitude control and approach coupler is fitted, together with full airframe and propeller de-icing, extensive radio equipment and underwing pylon tanks (as shown by the photograph).

B-26 Designed by Douglas, the B-26B Invader is powered by two Pratt and Whitney R-2800-CB-16 engines, rated at 2,400 h.p. with water injection, and driving Hamilton Standard reversing propellers. Although of somewhat small cross-section, the fuselage is luxuriously furnished for eight passengers in four large reclining chairs and a divan. The cabin is "super-soundproofed" and provided with a toilet and extensive storage facilities, and optional equipment includes the following: Sperry A-12 autopilot; Bendix X-band and weather radar; Collins Integrated Flight System; Bendix D.M.E.; Sperry engine analyzers, and the following radio equipment—sufficient to take the aircraft anywhere in the world—Collins 51R3 Omni receiver, Bendix Omni receiver, 17L3 Collins transmitter, series 440 Wilcox 50W V.H.F. transmitter simplexed with Wilcox receiver, dual Collins R.M.I., dual A.D.F. Bendix MN62, Bendix marker-beacon receiver, F-11A isolation amplifier, cockpit and cabin speakers, Collins 51V glide-slope receiver, and R89 glide-slope receiver.

William C. Wold Associates, 551 Fifth Avenue, New York.

(*Continued on page 598 after tables*)

Wold Lodestar interior.

Wold-engineered Douglas B-26 (two Pratt and Whitney R-2800 Double Wasp).

Business and Touring Aircraft 1957

WHAT THE WORLD'S MANUFACTURERS HAVE TO OFFER

Country, maker and type	Span (Note 1) ft in	Length ft in	Powerplant No.	Powerplant Type	Powerplant Total T.O. power (Note 2)	Normal gross weight lb	Disposable load lb	Seats	Performance Max. cruising speed m.p.h.	Performance Stalling speed m.p.h.	Performance Max. still-air range st. miles	Performance Initial rate of climb ft/min	Performance Take-off distance ft	Performance Single-engine ceiling ft	Price (Note 3) £
Great Britain															
Auster Aircraft:															
Agricola ...	42 0	28 0½	1	Cont. O-470-M2	240	3,675	1,680	1/3	123	44	218	610	555	10,500	8,500
Alpine	36 0	23 2	1	D.H. Gipsy Major 10	145	1,827	470	3/4	112	31	460	1,025	270	22,000	3,775
Atlantic	36 0	23 10	1	Cont. E185-10	205	2,700	754	4	135	50	450	1,150	675	—	—
Autocar	36 0	23 2	1	D.H. Gipsy Major 10	145	2,400	987	4	111	34	425	620	735	16,000	3,700
Aviation Traders (Engineering):															
Accountant ...	82 6	62 1	2	R-R. Dart RDa.6	3,460	28,500	13,400	28/40	294	79	2,420	1,500	1,770	15,000	120,000
Civil Prentice ...	46 0	31 6½	1	D.H. Gipsy Queen 30/2	250	4,360	1,000	4/5	126	69	440	550	1,800†	10,500	1,825
Bristol Aircraft:															
Sycamore (H) ...	48 7	42 0	1	Alvis Leonides 73	515	5,400	1,340	5	105	—	290	1,300	—	15,500	—
de Havilland Aircraft:															
Dove 6	57 0	39 3	2	D.H. Gipsy Queen 70	760	8,800	2,922	11	202	74	880	920	2,430†	—	35,900
Heron 2	71 6	48 6	4	D.H. Gipsy Queen 30	1,000	13,500	4,686	17	191	75	1,560	1,075	2,424†	10,650*	58,000
Jackaroo Aircraft:															
Jackaroo Mk 2 ...	30 4½	25 5	1	D.H. Gipsy Major Mk 1	130	2,180	550	4	85	45	280	500	—	8,500	1,095
Edgar Percival:															
E.P.9 (normal) ...	43 6	29 6	1	Lyc. GO-480B	270	3,700	1,690	6	142	35	580	1,120	315	17,500	9,360
(agricultural)	43 6	29 6	1	Lyc. GO-480B	270	4,140	2,130	1/3	140	35	—	800	525	—	9,775
Hunting Percival:															
President Executive	64 6	46 0	2	Alvis Leonides 514	1,120	13,300	4,346	12	215	77	1,050	1,070	2,520†	8,750	59,000
Vickers-Armstrongs (Aircraft):															
Viscount 700 executive	93 8	81 9	4	R-R. Dart RDa.6	6,920	60,000	25,550	22	326	96	2,420	1,270	4,650‡	—	375,000
Westland:															
Widgeon (H) ...	49 2	41 2	1	Alvis Leonides 521/1	515	5,900	1,477	5	101	—	300	600	—	10,300	27,000
Australia															
Kingsford Smith:															
PL-7 Tanker ...	40 9	24 6	1	A.S. Cheetah X	400	5,000	2,770	1	112	35	360	740	830	13,800	—
Canada															
de Havilland (Canada):															
Agricultural Beaver	48 0	34 4	1	P. & W. Wasp Junior	450	5,100	1,994	7	135	45	450	1,020	560	18,000	—
U.S.A.															
Aero Design:															
Commander 560E	49 0	35 0½	2	Lyc. GO-480	590	6,500	2,200	7	210	66	1,715	1,450	1,452†	8,000	26,600
Commander 680 Super	41 0	35 5	2	Lyc. GSO-480	680	7,000	2,670	7	230	71	1,600	1,600	1,575†	15,000	32,000
Beechcraft:															
Travel Air	37 10	25 4	2	Lyc. O-360	360	4,000	1,420	4	200	68	1,400	1,350	1,050†	6,200	17,630
Bonanza 35 ...	32 10	25 2	1	Cont. O-470-G	240	2,900	1,067	4	196	57	1,170	1,250	670	19,800	8,050
Twin Bonanza E50	45 3	31 6	2	Lyc. GSO-480	680	7,000	2,560	4/7	228	80	1,280	1,620	1,250†	11,550	31,400
Super 18	49 8	35 2	2	P. and W. R-985	900	9,300	3,250	7/9	215	78	1,626	1,350	1,800†	—	38,145
Bell:															
47J (H)	37 2	43 4	1	Lyc. VO-435	220	2,565	1,055	4	100	—	194	—	—	15,900	—
Camair:															
480	34 8	28 0	2	Cont. O-470	480	4,323	1,373	4	192	62	900	1,750	905†	6,600	—
Cessna:															
620	55 0	41 6	4	Cont. GSO-526A	1,400	15,000	5,000	11	260	—	1,700	1,150	—	20,000*	134,000
172	36 0	25 0	1	Cont. O-300-A	145	2,200	940	4	124	52	620	660	—	13,300	3,200
180	36 0	26 0	1	Cont. O-470-K	230	2,550	1,070	4	160	56	—	1,130	—	21,500	4,750
182	36 0	26 0	1	Cont. O-470-L	230	2,550	1,040	4	155	56	805	1,030	—	19,800	4,980
310B	36 0	27 0	2	Cont. O-470-M	480	4,700	1,735	5	213	74	975	1,660	—	7,750	21,300
CH-1A (H)... ...	35 0	42 9	1	Cont. FSO-470	260	3,000	1,025	2	120	—	270	1,150	—	11,000	—
Champion:															
Tri-Traveller ...	35 2	21 8	1	Cont. 90-C12F	95	1,500	532	2	108	40	500	900	250	—	2,100
Colonial:															
Skimmer	34 0	23 6	1	Lyc. O-320	150	2,150	700	3	120	50	598	700	550	—	5,520
Fairchild:															
M-185F	57 0	56 0	4	Fairchild J83	8,000	—	—	10	540	—	2,650	—	—	35,000*	350,000
Fletcher:															
FU-24 Utility ...	42 0	31 10	1	Cont. O-470	225	3,500	1,630	1	111	42	370	625	870†	15,700	—
Forney:															
Aircoupe	30 0	20 2	1	Cont. C-95	95	1,400	510	2	120	56	500	600	500	18,000	2,230
Grumman:															
Gulfstream... ...	78 0	64 0	2	R-R. RDa.7	4,200	31,000	19,000	14	370	—	2,600	2,300	4,000‡	—	250,000
Helio:															
Courier	39 0	30 0	1	Lyc. GO-435	260	3,000	1,100	4	157	30	600	1,100	495†	25,600	8,750
Hiller:															
12C (H)	35 0	27 10	1	Frank. 6V4-200	200	2,500	858	3	76	—	138	770	—	11,500	—
Howard:															
Super Ventura ...	—	—	2	P. and W. R-2800	4,800	29,000	11,000	16	300	90	2,600	2,170	4,650‡	12,200	160,000
Lamson:															
Air Tractor ...	33 7	26 8	1	P. and W. R-985	450	5,500	2,530	1	—	—	—	450	990	—	—

Country, maker and type	Span (Note 1) ft in	Length ft in	Powerplant No.	Powerplant Type	Powerplant Total T.O. power (Note 2)	Normal gross weight lb	Disposable load lb	Seats	Performance Max. cruising speed m.p.h.	Performance Stalling speed m.p.h.	Performance Max. still-air range st. miles	Performance Initial rate of climb ft/min	Performance Take-off distance ft	Performance Single-engine ceiling ft	Price (Note 3) £
U.S.A. (continued)															
Larson:															
D-1	33 10	27 0	1	Lyc. R-680	225	3,600	1,900	1	90	40	—	1,400	200	—	—
Lockheed:															
JetStar	53 8	58 10	{2 Wr. TJ37 / 4 G.E. J85}		{9,700 / 10,000}	28,000	12,700	12	580	86	1,700	3,700	3,500‡	—	310,000
Mooney:															
Mk 20	35 0	23 2	1	Lyc. O-320	150	2,450	1,035	4	165	53	900	900	600	17,200	5,110
National:															
No. 75	33 0	24 9	1	Cont.	220	3,862	1,250	1	—	35	—	420	890	—	—
	33 0	24 9	1	P. and W. R-985	450	4,612	2,000	1	—	35	—	550	785	—	—
North American:															
Sabreliner	—	—	2	G.E. J85	5,000	14,350	—	11	500	—	1,380	—	2,300	23,000	—
Northern Aircraft:															
Cruisemaster	34 2	21 8	1	Cont. O-470-K	230	2,700	1,070	4	205	46	1,000	1,250	—	20,000	5,640
On Mark:															
Model 450	72 4	64 0	2	Allison 501D	7,500	40,000	17,000	14	422	—	—	3,220	2,070	—	356,000
Pacaero:															
Learstar 1	65 6	49 10	2	Wr. R-1820	2,850	24,000	9,000	12	302	94	3,800	1,500	2,300†	8,400	161,000
Learstar 2	65 6	49 10	2	Wr. R-1820	2,700	24,000	9,000	12	298	94	3,800	1,500	2,300†	9,200	161,000
Piper:															
Comanche	—	—	1	Lyc. O-360	180	—	—	4	160	—	1,100	—	—	—	4,720
ƒ Apache	37 0	27 1	2	Lyc. O-320	300	3,500	1,320	4	170	52	1,260	1,350	900	6,750	12,230
ƒ Tri-Pacer	29 4	20 7	1	Lyc. O-320	150	2,000	900	4	132	49	550	724	—	15,000	2,890
PA-18A Agricultural	35 4	22 6	1	Lyc. O-320	150	2,070	1,010	1	90	45	360	760	300	17,000	2,450
Taylorcraft:															
Zephyr	34 8	24 4	1	Cont. O-470-J	225	2,750	1,025	4	150	—	540	1,000	—	15,000	4,950
Topper	34 8	24 4	1	Cont. O-470-J	225	2,750	1,115	1/4	100	65	300	1,000	—	15,000	4,760
Temco:															
Riley Twin	33 10	27 2	2	Lyc. O-340-A	340	3,600	1,250	4	170	58	1,200	1,400	—	8,000	—
Transland:															
Ag-2	42 0	27 11	1	P. and W. R-985	450	5,200	2,455	1	122	48	—	900	940†	—	10,160
Wold Associates:															
Lodestar			2	Wr. R-1820-704	2,400	—	—	—	—	—	—	—	—	—	—
Dakota			2	P. and W. 1830-75	2,400	—	—	—	—	—	—	—	—	—	—
B-26B			2	P. and W. R-2800	4,800	—	—	—	360	—	—	—	—	—	—
Czechoslovakia															
Omnipol:															
Meta Sokol	30 6	23 0	1	Walter Minor 332	140	2,050	1,170	4	120	47	530	860	730	22,300	—
Brigadyr	42 6	26 0	1	Praga Doris 208B	220	3,120	2,015	2/4	95	32	435	805	740†	13,700	—
Super Aero	40 4	24 8	2	Walter Minor 4-III	210	3,520	1,410	4	146	50	1,000	870	720	4,500	—
Morava	41 2	23 8	2	Walter Minor	320	4,120	1,700	5	171	—	1,000	—	1,320	—	—
France															
Paul Aubert:															
Super Cigale PA.204	32 9	24 6	1	Lycoming	150	2,750	1,250	4	144	56	1,160	890	738	14,764	—
Boisavia:															
Mercurey	37 4	23 8	1	Lycoming	150	2,800	1,380	4	125	37	755	1,085	440	16,400	—
Anjou	42 3	23 4	2	S.N.E.C.M.A.	320	4,110	1,930	4/5	165	—	1,240	1,190	—	—	—
Max Holste:															
Broussard	45 0	28 2	1	P. and W. R-985	450	5,511	2,248	7	168	53	750	1,182	607	19,700	—
Super Broussard	71 8	53 2	2	P. and W. S3H1-G	1,200	14,590	4,712	17	187	63	1,220	1,570	648	15,100	—
Morane Saulnier:															
Paris	33 3	32 11	2	Turb. Marboré II	1,766	7,500	3,155	4	350	96	930	2,264	2,460	12,000	—
Sud Aviation:															
Gouverneur (H)	33 6	31 10	1	Turb. Artouste 2	360	3,300	1,265	5	124	—	370	880	—	10,500	—
Germany															
Dornier:															
Do 27	39 4	31 4	1	Lyc. GO-480	270	2,977	960	6	140	35	547	—	466†	20,350	10,000
Italy															
Aviamilano:															
Falco	26 2	21 4	1	Lyc. O-290-D	140	1,715	583	2	187	53	690	1,070	490	19,000	—
Nibbio	—	—	1		180	—	—	4	—	—	—	—	—	—	—
Macchi:															
M.B. 320	42 7	28 5	2	Cont. E-225	450	5,500	1,743	6	156	80	666	1,220	726	3,780	19,500
Meteor:															
F.L. 54	32 5	20 10	1	Cont.	90	1,543	600	3	100	35	230	800	300	13,000	2,180
F.L. 55	32 5	20 10	1	Lyc.	150	1,776	836	4	110	40	250	800	300	18,000	3,890
Nardi:															
FN.333	33 4	23 11	1	Cont. O-470-H	240	2,865	1,015	4	166	63	900	1,200	785	20,000	—
Pasotti:															
Airone	34 7	23 9	2	Walter Minor	210	3,087	1,213	4	162	56	745	—	655	5,900	—
Piaggio:															
P.136 L	44 4	35 5	2	Lyc. GO-480	540	6,000	1,746	5	164	68	1,056	—	—	4,593	—
P.136 L2	44 4	35 5	2	Lyc. GSO-480	640	6,600	1,930	5	190	72	900	1,280	1,440†	11,800	—
P.149D	36 6	28 9	1	Lyc. GO-480	270	3,700	1,190	4/5	167	57	610	1,050	730†	17,000	—
Netherlands															
Fokker:															
Friendship	95 2	75 9	2	R-R R.Da.6	3,484	34,520	12,520	40	280	73	1,135	1,480	2,500†	15,700	250,000
Holland-Air:															
HA-001	49 6	27 9	1	Lyc. O-290	135	—	—	1	90	40	—	1,200	330	—	—
N.H.I.:															
Kolibrie	33 0	13 1	2	N.H.I. TJ-5 ramjets	120	1,323	883	2	62	—	60	—	—	—	—
Japan															
Fuji:															
LM-1 Nikko	32 9	25 11	1	Cont. O-470	240	3,245	1,165	4/5	158	55	895	990	584	15,000	—

Note 1. Wing span or rotor diameter.

Note 2. Figure refers h.p., e.h.p. or lb thrust as appropriate for type of engine. In the case of the Kolibrie helicopter ramjets, the figure is equivalent h.p.

Note 3. These are quoted prices, ex-works, for the basic type, but should not be taken as final.

* Three-engined in the case of four-engined aircraft. † Take-off distance to clear 50ft obstacle. ‡ Balanced field length.

Engine name abbreviations: R-R. Rolls-Royce, D.H. de Havilland, A.S. Armstrong Siddeley, Turb. Turbomeca, Lyc. Lycoming, Cont. Continental, P. and W. Pratt and Whitney, Wr. Wright, G.E. General Electric, Fairch. Fairchild.

Business and Touring Aircraft . . .

CZECHOSLOVAKIA

Omnipol

Morava The Morava (L200) is an all-metal five-seater with Walter Minor 6-III engines of 160 h.p. driving electrically controlled v.p. propellers. The nosewheel is steerable and the machine has de-icing equipment. A twin-fin empennage and wing-tip fuel tanks give this promising new aircraft a distinctive appearance. The luggage compartment is accessible both from inside and outside.

Meta-Sokol This pleasant little touring aeroplane (it is suitable also for instruction) has a Walter Minor 4-III engine driving a variable-pitch propeller, the pitch being operated either mechanically or electrically. The retractable undercarriage is quite unorthodox in that the third wheel is level with the trailing edge of the wing. It is steered from the rudder pedals.

Brigadyr (Agricolta) A multi-purpose high-wing monoplane, the Brigadyr went into production at the end of 1956 and over 50 have been built. The type is of all-metal construction. Agricultural work was much in mind when the design was planned and provision is made for a 77-gallon hopper for powders or liquids. The spraying gear can be driven either by an auxiliary propeller or by electrical means. The 220 h.p. Praga Doris B engine, in conjunction with a low wing area, full-span slots and slotted flaps and drooping ailerons, gives a very short take-off run; and the landing run is correspondingly brief. Dual control can be fitted, together with blind-flying panel, radio and electrical services for night flying.

Super Aero This fine little aeroplane was the subject of an air test described in *Flight* of July 26 last. The following are extracts:

"Though precious few foreign aircraft of the executive type can be imported into Britain, the Anglo-Czechoslovak trade agreement will allow a limited number of Super Aeros to be sold here. The price is quoted as £7,960 ex-works in Prague without radio, though customer's radio would be fitted free. Import duty of 17.5 per cent and ferrying charges must be added to the basic price. Three machines may be imported this year and the manufacturers are quoting six to eight weeks' delivery time from receipt of order. The agents here are the Aircraft and General Finance Corporation, Ltd., 26/27 Poultry Chambers, 11 Poultry, London, E.C.2, and spares to the scale recommended by the manufacturers are to be stocked by Rollason Aircraft and Engines, Ltd., at Croydon Airport. . . .

"The Super Aero has two 105 h.p. engines with electrically-variable-pitch metal propellers which can be feathered. Carrying four people and full fuel load of 71 gal it will cruise at 148 m.p.h. for 870 miles. At 62 m.p.h., its stalling speed is a good deal higher than that of the Gemini, but it has a maximum flap deflection of 55 deg, which produces a really steep glide. Because of their high drag, flaps must be raised immediately to gain height when overshooting. Both flaps and undercarriage are electrically operated. In fact, engine and blind-flying instruments, propeller controls and a number of other services are electric and have to be switched on individually, together with battery and two generators. All this makes for a good deal of wiring, but the lower portion of the nose-cone can be hinged down to give direct access to the back of the instrument panel, the battery and electrical equipment. Four ashtrays are fitted.

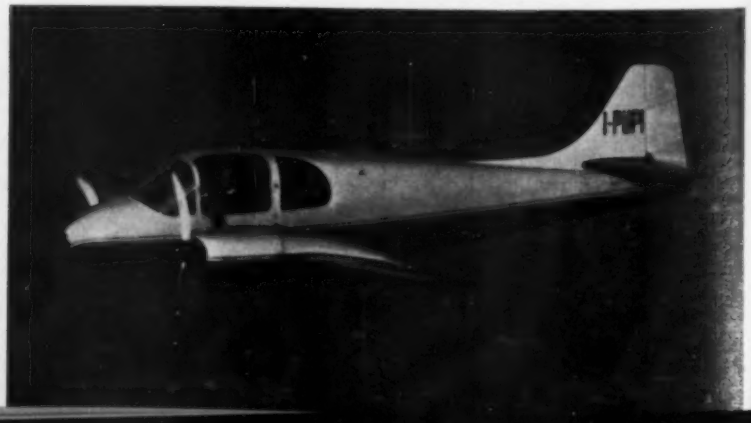
"With a maximum load factor of 3.8 or 4 the Super Aero is not really aerobatic, but demonstrations of two- and single-engined aerobatics with two and three occupants have been given very successfully. Blaha showed me an upward roll, from the deck up into a hole in cloud, which convinced me that, load factor or no load factor, the Super Aero can be gracefully and satisfyingly aerobatted. . . .

"The Super Aero is a sleek machine and offers an excellent compromise between real performance and range and highly commendable economy. It nevertheless carries 'grown-up' equipment without unnecessary complication. Full navigation and communications radio, both M.F. and V.H.F., has been installed in many of the Super Aeros sold in Switzerland. The machine in fact offers the performance (and equally important the intelligent design and good workmanship) of the smaller American light twins, but retains the 'feel' of a pilot's aeroplane which distinguishes a European aircraft."

Omnipol, Ltd., Washingtonova 11, Prague 3, Czechoslovakia.

Omnipol Morava (two Walter Minor 6-III). Below, Brigadyr (Praga Doris B).

Omnipol Super Aero (two Walter Minor 4-111). Below, left, interior. Below, right, Pasotti Airone (two Lycoming O-290).



Business and Touring Aircraft . . .

ITALY

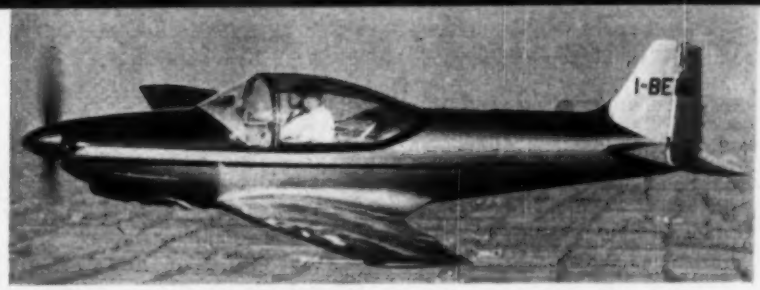
Aviamilano

F.8L Falco Although only a two-seater, the Falco is included here as it is very much an aeroplane for the man who wishes to go about his business in a hurry. It was air-tested by C. M. Lambert on the occasion of the recent Paris Salon and his report was in these terms: "I would say without any hesitation that the Italian Aviamilano Falco is the finest light aircraft I have flown—a real pilot's machine, a small fighter and a two-seater fit for kings to show their ladies. It has gorgeous lines. But it is no quirk, no 'hot ship.' It is a superb completely equipped little aeroplane, fully aerobatic, but with plenty of room for baggage and radio equipment; and a cruising speed, on 140 h.p., of 168 m.p.h. . . .

"On the way back to Le Bourget we tried the maximum level speed and settled at 181 m.p.h. It should not be forgotten that we had only 140 h.p. and a fixed-pitch wooden propeller. In the circuit Biancotto lowered wheels and flap at 100 m.p.h. and made a curved approach at that speed. The rate of descent was 1,200ft/min. We touched down at 81 m.p.h. and dropped the nosewheel straight away. The landing run was quite short."

F.14 Nibbio The Nibbio is a development of the Falco with the Lycoming O-360 engine of 180 h.p. and with a brilliant performance as set out in the table on page 597. Maximum continuous cruising speed is no less than 190 m.p.h.

Aviamilano, Via Macedonio Melloni, 70, Milan, Italy.



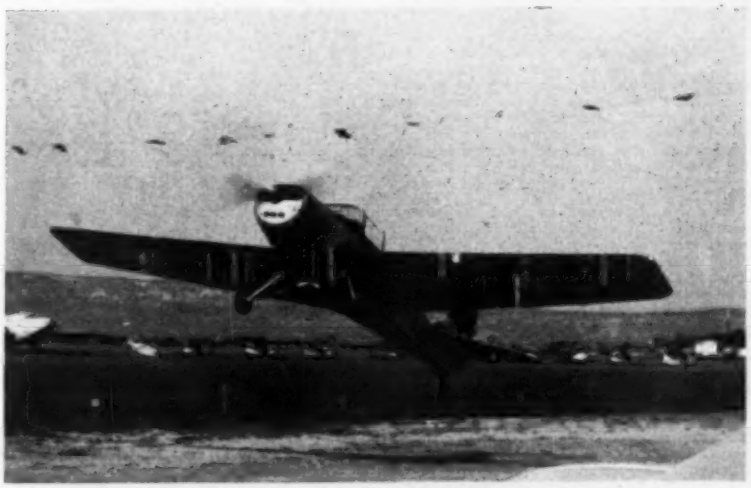
Aviamilano F.8L Falco (prototype is shown).

Above, Nardi FN.333 (Lycoming O-470H). Below, Macchi MB.320 (two Continental E-225).

Macchi

MB.320 The latest version of the MB.320 has two Continental E-225 engines driving S.I.A.I. Marchetti constant-speed fully feathering propellers. A six-seater, the MB.320 is of wooden construction, with plywood skin. Standard equipment includes dual controls, V.H.F. and H.F. radio, radio compass and automatic pilot. The cabin is soundproofed and air-conditioned, and there is a baggage compartment behind the seats.

Aeronautica Macchi S.A., Corso Vittorio Emanuele 31, Milan, Italy.



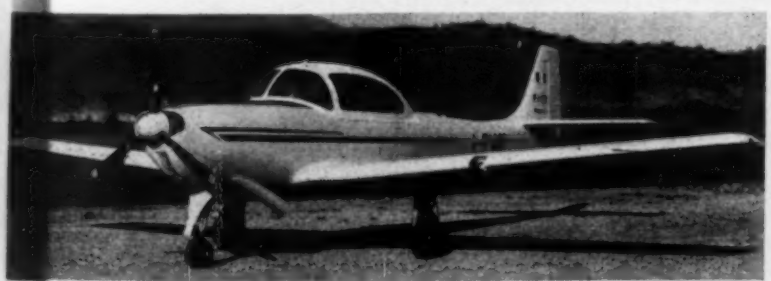
Meteor

FL.55C Cargo/Agricultural This is the latest of the Meteor series, which has included the FL.53 two-seater for training and touring; the FL.54 three-seater for similar work, the FL.55 four-seater; and the FL55B—a development of the 55 with more powerful engine (Lycoming 150 h.p.). The FL.55C is likewise a four-seater but can be adapted particularly for agricultural work. The adjustable spraying nozzles can be easily inspected and their operation is automatically stopped in case of loss of pressure. When dusting powder is carried it is sufficient to mount a special venturi device on the outlet of the tank and to remove the spraying pipes. The small propeller-driven pump is replaced by an air-driven agitator device.

The new Meteor has balloon wheels, flaps, independent hydraulic brakes and castering tailwheel. Spraying equipment weighs 770 lb and the dusting equipment 880 lb.

Meteor Costruzioni Aeronautiche, 2 Via Milano, Trieste, Italy.

Above, Meteor FL.55 (Lycoming O-320). Below, Piaggio P.149 (Lycoming GO-435-C2). Lower right, interior of the same aircraft.



Business and Touring Aircraft . . .

Nardi

FN.333 The prototypes of this amphibian are being built by Fiat. As seen at the recent Paris Show the aircraft had tiny bullet-shaped retractable floats and a retractable nosewheel undercarriage. The engine is a Lycoming 240 h.p. mounted to drive a pusher propeller. Construction is all-metal and the cabin seats three or four. The tail is carried on two booms.

Nardi S.A. Per Costruzioni Aeronautiche, Aeroporto Forlanini, Milan, Italy.

Pasotti

F.6 Airone Production versions of this very clean-lined four-seat twin-engined aircraft have two Walter Minor 4s of 105 h.p. each, driving variable-pitch feathering propellers. More powerful American engines are in view. In production aircraft all fuel is carried in permanently attached tip-tanks. The Italian test pilot Vico Rosaspina reported on flying the prototype in *Flight* of July 13, 1956, and declared that after three circuits a pilot with only 100 hours' experience—none of it on twins—could manage the Airone. He concluded his report: "By virtue of the Airone's robustness, Stelio Frati has already produced definite designs for a jet-propelled version powered by two Turbomeca Palas. The only structural modification would be the use of a slightly thicker plywood skin on the wing which would bring the maximum permissible diving speed up to 340 m.p.h. Since the Airone has no pressure cabin it would probably cruise at 13,000ft to 16,400ft using one engine only.

Legnami Pasotti, Via Massimo d'Azeglio 6, Brescia, Italy.

Piaggio

P.149 This 4/5-seater is a development of the P.148 military trainer. It has a nosewheel undercarriage and is powered with a Lycoming GO-480 engine. Dual controls are standard and the notably clean canopy slides rearwards.

P.136 This twin-engined amphibian (Lycoming GO-480 B1B) is being assembled and sold in the United States and Mr. Fred J. Bunyan reports in our contemporary *Flying*: "This is an interesting airplane, rugged, beautifully designed, well-powered, excellent in single engine performance and easy to handle, even for me, on the water. I judge it will grow popular among those who have need for amphibious utility. It is apparently the only twin engine amphibian in its class now in the American market."

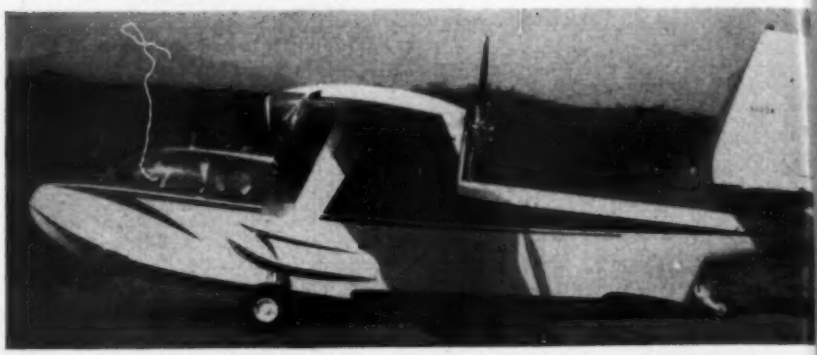
Piaggio and C., Via Antonio Cecchi 6, Genoa, Italy.

SPAIN

Hispano

HA.231-R1 Development A fast executive or liaison aircraft based on the HA-200-R1 jet trainer is being developed. It will have a pressurized, air-conditioned and soundproofed cabin. Initially this six-seater will have Marboré turbojets but the more powerful Gabizos may eventually be specified. Fuel will be carried in wing and wing-tip tanks.

La Hispano Aviacion S.A., Avenida Jose Antonio 7, Madrid, Spain.



Piaggio P.136 (two Lycoming GO-480B1B). Below, Fuji LM-1 (Continental O-470-13A).

NETHERLANDS

Fokker

Friendship The Fokker company presents its executive de-luxe version of the Friendship transport (two Rolls-Royce Dart) in these terms: "In the first instance the Fokker F.27 Friendship has been designed—and is now being built in quantity in Holland and in the United States—as a modern twin-turboprop airliner for 32-40 passengers, to replace gradually all over the world the now obsolescent aircraft of pre-war design. However, soon after the Friendship became known in international aviation, a growing interest was aroused in using this versatile aircraft also as an *executive de-luxe airplane* for chiefs of state—the Netherlands Government has already ordered one for the Royal Family—high-ranking government officials, directors of big industrial and commercial enterprises, etc. For this Friendship de-luxe a special cabin layout has been designed in which 10-16 passengers can travel in a fast and very comfortable way. The flying time can pleasantly be spent in one of the three luxurious compartments: a conference-corner, a cabin with couches for taking a rest, or a 'cosy-corner' for a chat or game of bridge. Other cabin layouts can of course be made according to customer's requirements. . . .

"The high-wing configuration and the large windows ensure an unimpeded downward visibility for all passengers, and prevent that inconvenient reflection of sunlight on the wing, which is often experienced in low-wing aircraft. The Friendship combines an economical cruising speed of 275 statute miles per hour with a low landing speed, the latter enabling the aircraft to be operated from smaller airfields than those currently being used by aircraft of the size and speed of the Friendship. . . ."

The N.V. Koninklijke Nederlandsche Vliegtuigenfabriek Fokker, Schiphol-Zuid, Amsterdam, Holland.

N.H.I.

Kolibrie H-3 This tiny one- or two-seater helicopter is particularly well suited to agricultural work. It can be operated, if required, from floats (as seen in the picture).

Netherlands Helicopter Industry N.V., Rotterdam Airport, Holland.

Holland-Air

HA-001 This Katwyk company is building a high-wing monoplane with under-wing spray tanks and 130 h.p. Lycoming engine.

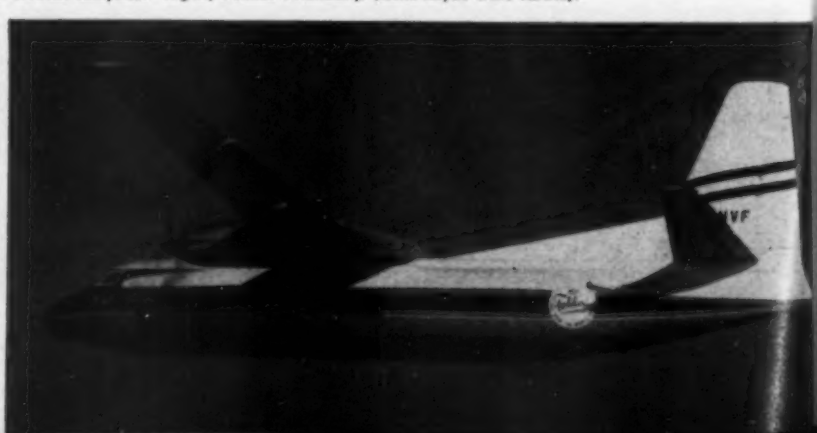
JAPAN

Fuji

LM-1 Nikko Powered with a Continental O-470-13A engine, this is a 4/5-seater on the lines of the Beech Mentor, which type is also constructed by the Fuji company.

Fuji Heavy Industries, Ltd., Naigai Building, 18, 2-chome, Marunouchi, Chiyoda-ku, Tokyo, Japan.

Below, N.H.I. Kolibrie H-3 (N.H.I. ramjets). Right, Fokker Friendship (Rolls-Royce Dart RDa.6).



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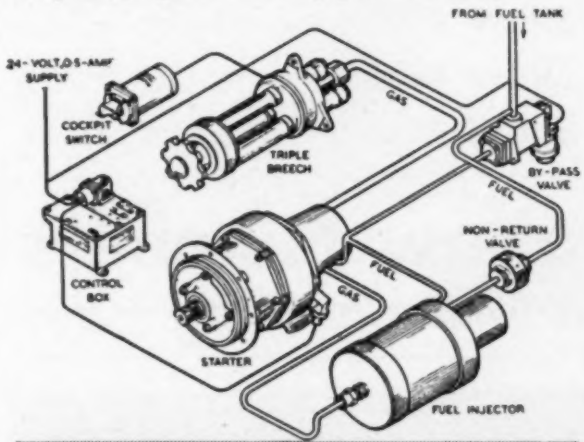

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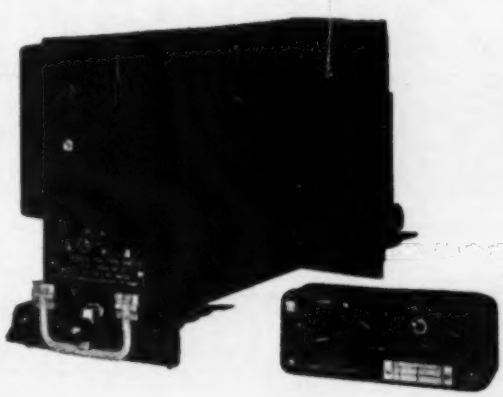

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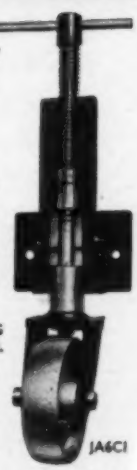

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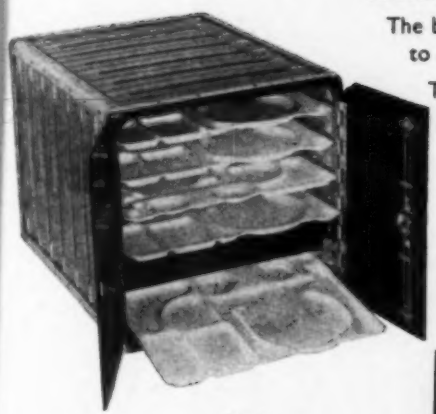

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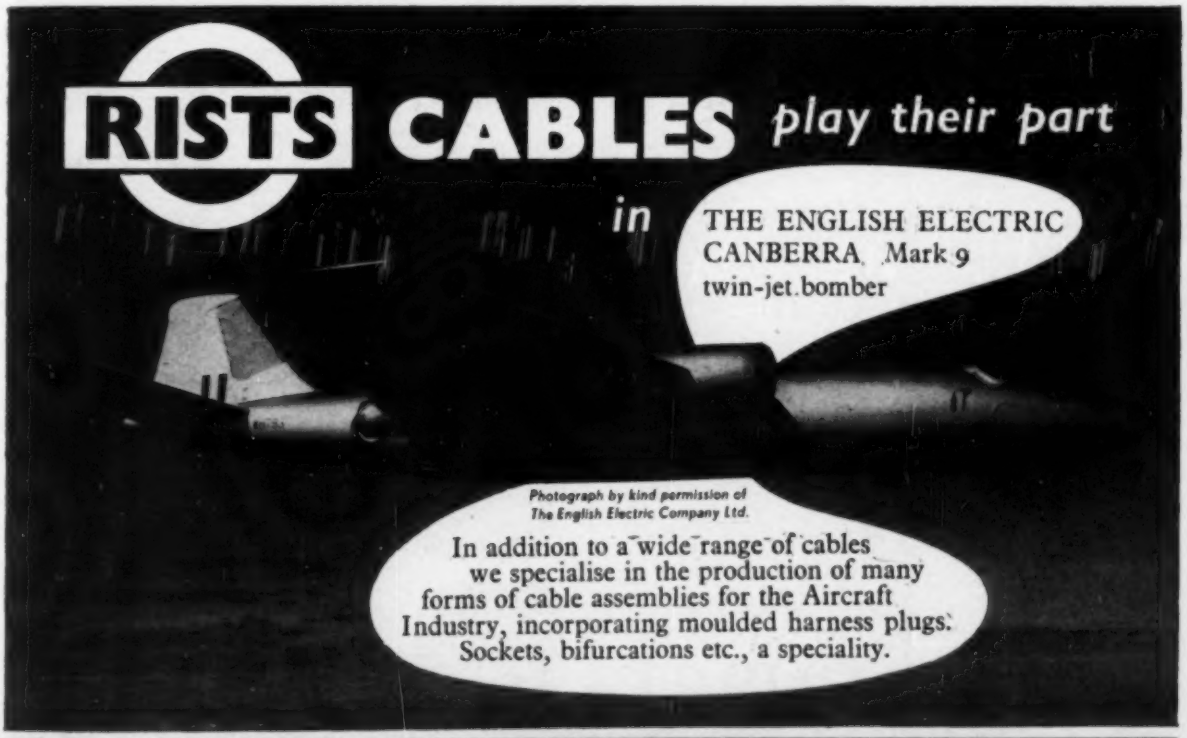

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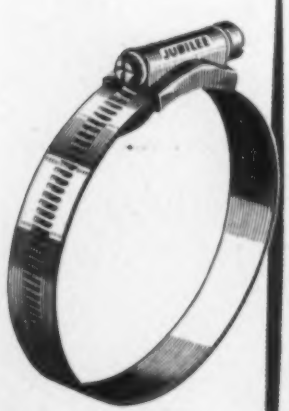

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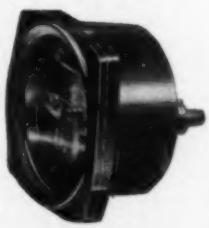

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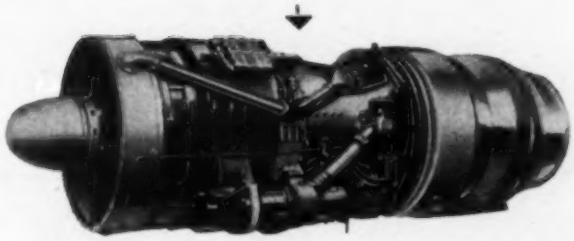

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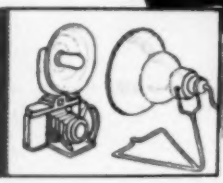

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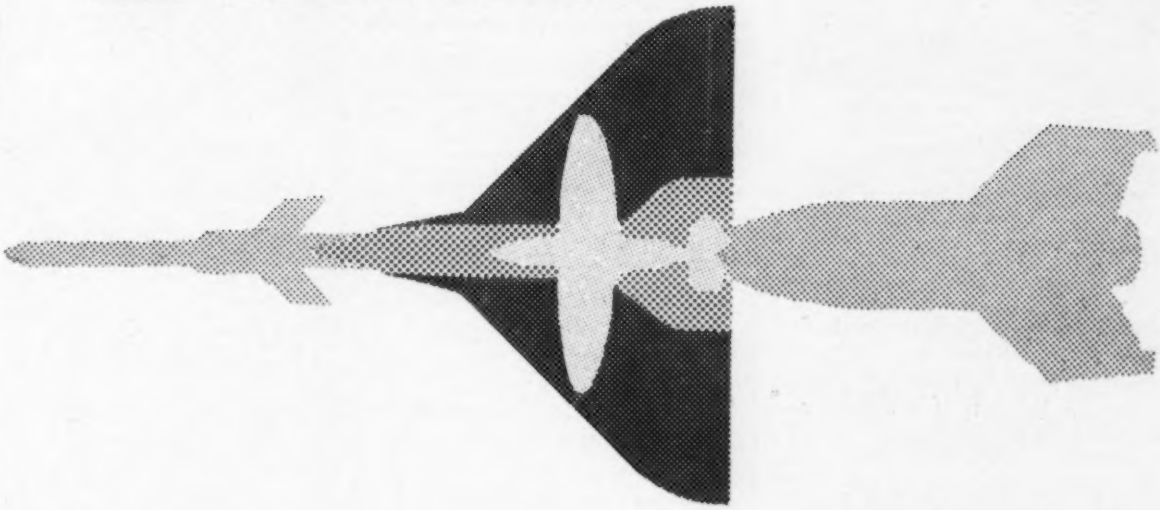

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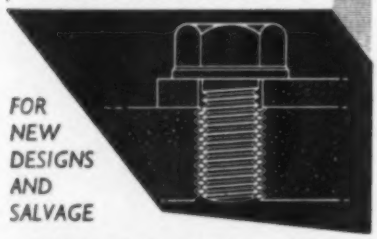

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APPLICATION form and further particulars from Civil Service Commission, Scientific Branch, 30 Old Burlington Street, London, W.1, quoting S 128/57 and stating date of birth.

INTERVIEW boards will sit at intervals, as required. Early application is advised. [7175

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM DRAGON AIRWAYS, LTD., of 1 Great Cumberland Place, London, W.1:—

APPLICATION Nos. 92/5 and 94/3 for amendments to the terms of approval of the following Normal Scheduled Services so as to permit them to operate with Dakota, D.H. Heron and Bristol 170 aircraft instead of Dakota, Viking, Viscount and D.H. Heron aircraft:—

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APPLICATION No. 93/3 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorized to operate on the route Newcastle - Amsterdam - Hamburg so as to permit them to operate with Dakota, D.H. Heron and Bristol 170 aircraft instead of Dakota, Viking and D.H. Heron aircraft.

APPLICATION No. 307/2 for an amendment to the terms of approval of the U.K. Internal Service which they are authorized to operate with D.H.89, D.H. Heron and Prestwick Twin Pioneer aircraft on the route Liverpool (Speke) - Prestwick (on demand) - Glasgow (Renfrew) so as to permit them to operate with Bristol 170, Dakota and D.H. Heron aircraft on the route Blackpool - Glasgow (Renfrew).

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [7178

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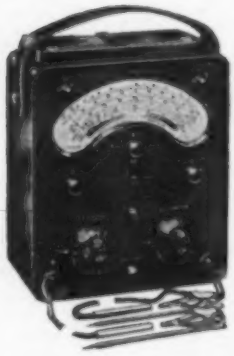

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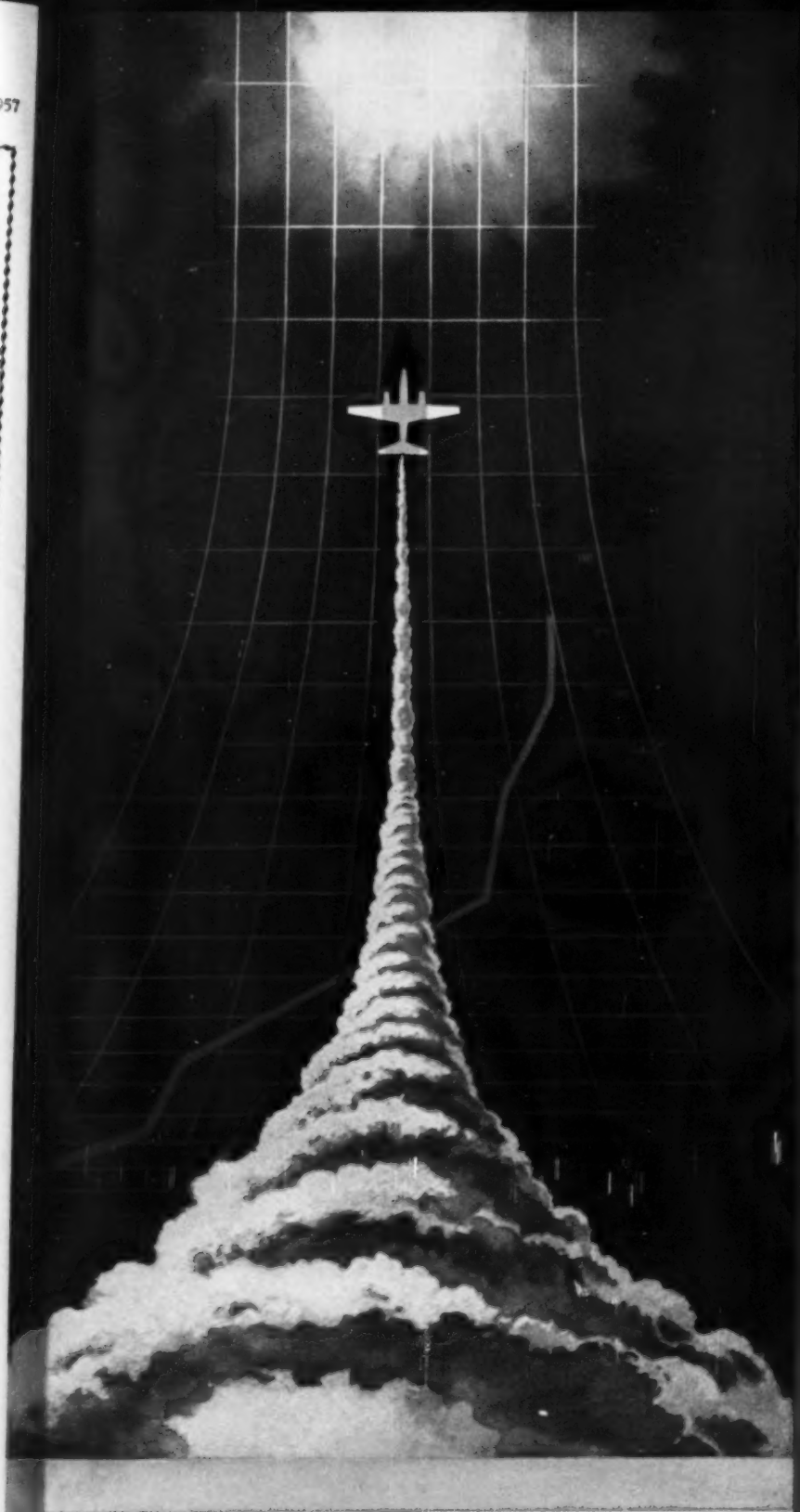

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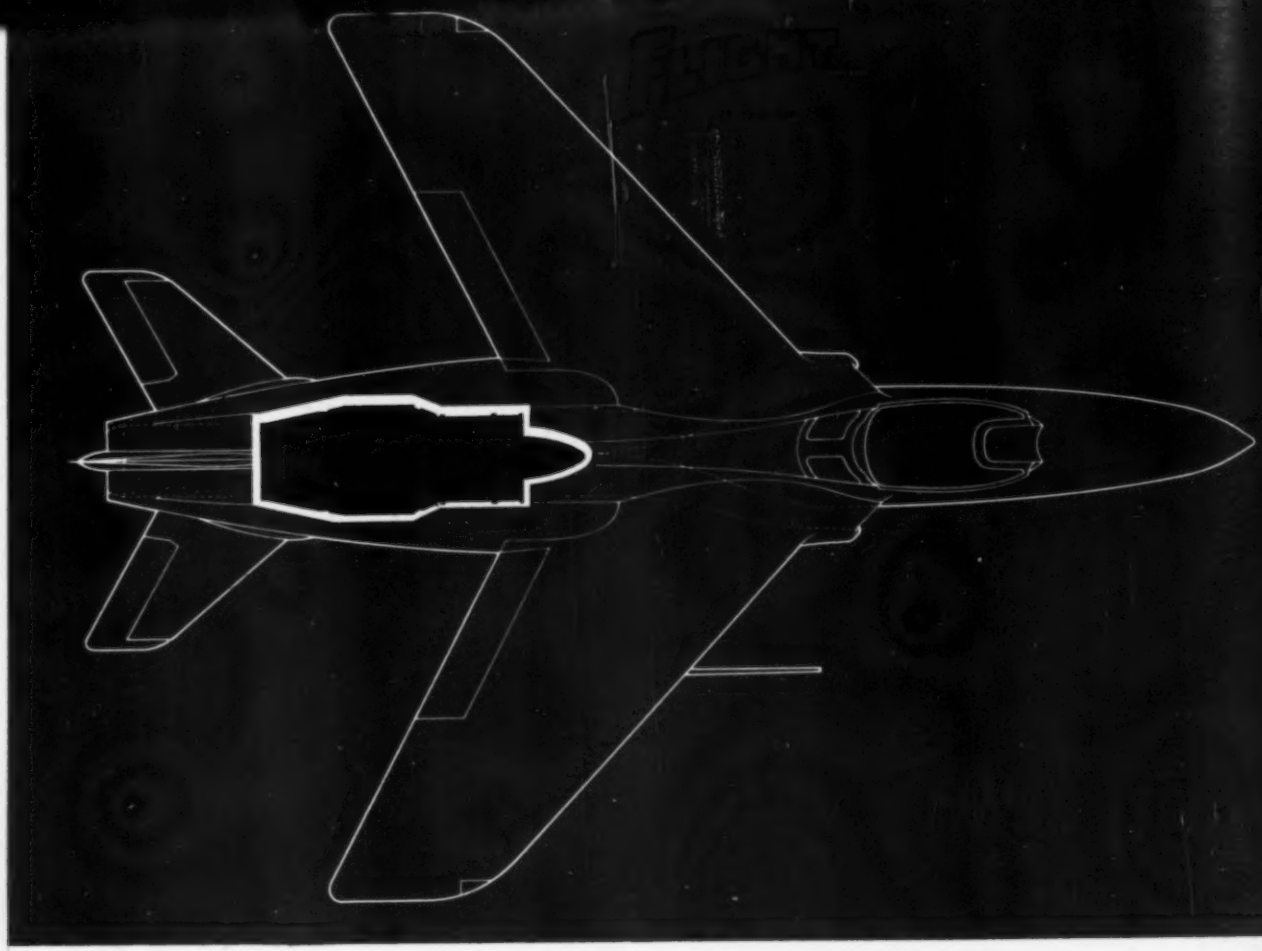

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